CALIFORNIA STATE MINING BUREAU
FERRY BUILDING, SAN FRANCISCO

FLETCHER HAMILTON State Mineralogist

PRELIMINARY REPORT No. 8 [January, 1922

A REVIEW OF MINING IN CALIFORNIA DURING 1921

WITH NOTES ON

THE OUTLOOK FOR 1922
LABOR CONDITIONS
NEEDS OF THE INDUSTRY

CALIFORNIA STATE PRINTING OFFICE
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LETTER OF TRANSMITTAL.

To His Excellency, HONORABLE WILLIAM D. STEPHENS,
Governor of the State of California.

SIR: I take pleasure in submitting herewith Preliminary Report No. 8 entitled "A Review of Mining in California During 1921," which includes notes on the mining outlook for 1922.

The information contained herein has been made available as a result of the Bureau's system of working through branch offices in the mining regions of the state. No attempt has been made to present the material in particularly finished form, its value lying in the timeliness of its appearance and the definite manner in which the subject is discussed.

It is believed that this publication will be appreciated by the general mining public, inasmuch as such authentic information has not commonly been available, in the past, until much later in the year.

Respectfully submitted.

FLETCHER HAMILTON,
State Mineralogist.

January 1, 1922.

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CALIFORNIA STATE MINING BUREAU
FLETCHER HAMILTON
STATE MINERALOGIST
OUTLINE MAP
OF
CALIFORNIA
SCALE
OREGON
NEVADA
MEXICO
PACIFIC OCEAN
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MODOC
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INTRODUCTION.

For over two years the State Mining Bureau has been carrying on its field work through district engineers in branch offices as shown on the map on the opposite page, and as a result of the personal contact with the mining industry thus achieved, it has been possible to greatly increase the efficiency of the service which the Bureau at all times strives to offer by way of aiding in the development of the natural resources of California.

The personnel of the technical staff carrying on this work in the various districts during 1921 was as follows:

E. S. Boalich, Chief Mining Engineer, San Francisco Field Division.

C. A. Logan, Mining Engineer, Auburn Field Division.

C. McK. Laizure, Mining Engineer, Redding Field Disvision.

C. S. Haley, Mining Engineer, Los Angeles Field Division (January to June).

M. A. Newman, Mining Engineer, Los Angeles Field Division (July to December).

The material offered in the following brief review is a compilation of the notes prepared by the above men, covering various phases of the mining industry which they have observed in the course of their work during the past year. It does not presume to be a detailed record of the mines and mineral deposits of the state, information of that nature being available in the XIV, XV, XVI and XVII Reports of the State Mineralogist, as well as in various bulletins which have been issued on particular branches of our mineral industry.

This review does, however, attempt to convey at a glance some idea of the general mining situation here, in 1921, and to mention items of interest which have been noted during that period, particularly as regards new development and activities, as well as to show something regarding the future outlook for this industry.

It is a pleasure to be able to state, in this connection, that even in the face of slack times in metal mining, California's mineral output as a whole has consistently increased.

So widely is the industry distributed and so diversified are its various products that a slump in some materials usually seems to be offset by a period of activity in another group. It is also a matter of great importance to the citizens of this state to realize that our potential mineral resources are almost unlimited, at least as far as the present generation and many coming generations are concerned.

Mining is second only to agriculture in importance here, and a careful study of the subject gives convincing proof that it is capable of expansion far beyond any limits that have been approached in the past.

FLETCHER HAMILTON, State Mineralogist.

A REVIEW OF MINING IN CALIFORNIA DURING 1921.

Every one of California's fifty-eight counties contributes in some degree to the total mineral output. Over fifty crude materials are included in that total.

It is difficult, if not impossible, to intelligently discuss an industry, as a whole, which covers such a large field, and it has therefore been deemed expedient to segregate the materials into five groups under the general classifications of Fuels, Metals, Structural Materials, Industrial Materials and Salines.

For the purpose of this report the above chapter headings will be used. If the reader is interested in a mineral substance which does not obviously belong to one of those groups, his attention is directed to the index, where all subjects covered will be found in alphabetical order.

FUELS.

REDDING DISTRICT.

The mineral fuels, coal, natural gas and petroleum, are of minor importance in the Northern California Field Division, although the latter forms by far the most important part of the mineral production of the state as a whole. In this district chiefly noted for its metal mines prospecting for oil, however, rivaled that for the metals during the past year, and there was scarcely a county in the district that was not visited by the promoter or oil expert, and as a result felt the throes of an oil excitement to some degree.

The presence of lignite coal strata in Humboldt, Modoc, Siskiyou, Shasta and Trinity counties associated with shales and sandstones, often fossiliferous, has been erroneously assumed to be first hand evidence of petroleum, and inferences drawn therefrom not warranted by a geological study of the areas.

It is probable that, with the possible exception of Humboldt County, where the indications of a commercial oil field are most pronounced, coal will eventually prove to be the most valuable of the mineral fuels of this district.

COAL.

Deposits of coal of workable size, some of which are of good quality, are found in Humboldt, Shasta, Siskiyou and Trinity counties; but the majority of the coal outcrops in these counties and those in Modoc, are low grade lignites, usually in rather thin beds. Occasionally these beds alternate with clay strata or slate a few inches thick, and produce a coal bearing formation from 14 to 20 or more feet thick, where large tonnages could be developed.

These coals have been used locally for blacksmithing and heating but have remained practically undeveloped on account of being too low grade or too far from transportation to compete with other coals or oil.

The full utilization of these low grade coals will rest on further developments in the use of powdered coal and automatic stokers; the low temperature distillation of coal, by which it is claimed a commercial hard coal may be produced from the lignites of the Pacific Coast and important quantities of motor fuel, lubricating and fuel oils and other by-products obtained; the manufacture of producer gas; or by the use of some process such as the Trent. The Trent process, stated briefly, as reported by the U. S. Bureau of Mines,[1] consists in agitating together powdered coal, water and oil. This produces a partly de-ashed plastic fuel, called an amalgam, the oil selecting the coal particles and largely excluding the water and ash.

In one experiment on a California lignite, the ash reduction amounted to 26.8 per cent, the combustible recovery was 95 per cent and the sulphur reduction was 12 per cent, after treatment.

The fact that some of the largest copper smelters in this country are now using powdered coal for furnace firing, suggests the possibility of using the coals of Shasta, Siskiyou and Trinity counties at some of the metallurgical or industrial plants in this district. It may also be the solution of the fuel question for a cement plant in Shasta County, the raw materials required being at hand and abundant electric power available. The advanced price of fuel oil during the past year has brought some inquiry regarding the various coal deposits, but no definite development has been undertaken.

NATURAL GAS.

A small amount of natural gas is produced and used locally in the Humboldt oil field, particularly at Briceland.

PETROLEUM.

The unusual interest in oil prospecting the past year resulted in the acquisition of oil land leases in nearly all the counties in this district by individuals, associations, 'drilling clubs' or companies and in some 'wild cat' drilling being started. Several of the counties were prospected during, and before, the boom days of 1900–1903. Drilling first began in the Humboldt field in 1865.

According to the State Oil and Gas Supervisor,[2] the following wells were drilled in this district with results noted, prior to December 31, 1903:

County	Producing wells	Abandoned wells	Wells drilling	Wells of doubtful value	Remarks as to results
Humboldt	0	14	0	0	Numerous traces of light oil
Shasta	0	3	0	0	Nothing
Tehama	0	2	0	0	Nothing

[1]Reports of Investigations, Serial No. 2263.
[2]Summary of Operations, California Oil Fields, March, 1921.

The following is an official list of prospecting operations started since January 1, 1920:

County and operator	Well No.	Section	Township	Range	Meridian
Del Norte:					
North Coast Oil and Refining Co.	1	24	16 N.	2 W.	M. D.
Humboldt:					
North Counties Oil Company	1	36	2 S.	1 W.	H.
Humboldt Oil Company	1	20	4 S.	3 E.	H.
Tehama:					
Tuscan Oil Company	1	25	28 N.	4 W.	M. D.

Drilling rigs were also operating in Siskiyou and Modoc counties during the year, but reports as to whether they were drilling for oil or water were conflicting. Considering all territory outside of the Humboldt field as 'wild cat' the greatest headway has been made by the Tuscan Oil Company, whose well is at present down between 1900 and 2000 feet. Blue shale is said to have been encountered, and the operators are hopeful of making a success of this enterprise.

AUBURN DISTRICT.

No oil or gas has ever been developed in the counties comprising this field division and while there are considerable deposits of lignite along the western boundaries of Amador and Placer counties, some of which have been productive in the past, the year 1921 recorded nothing of interest in this regard.

SAN FRANCISCO DISTRICT.

COAL.

Coal occurs in greater or less extent in twenty-three counties out of the twenty-eight in the San Francisco Field Division. Back in the 60's and 70's considerable tonnages of this fuel were placed on the market from mines in Contra Costa and Alameda counties which have lain dormant during recent years. During 1921 John Rosenfeld's Sons, Merchants Exchange Building, San Francisco, carried on some prospect drilling at a lignite deposit near Dos Rios on the Middle Eel River in Mendocino County, but it is understood that the results obtained were not particularly encouraging.

One of the most interesting of recent developments as regards coal in the entire state is the rehabilitation of the Stone Canyon mine, and reconstruction of the twenty-two mile railroad from that property to the main line of the Southern Pacific at McKay, Monterey County.

It was first reported in July that this mine had been sold to eastern capitalists for $1,500,000.

When visited by a representative of the Bureau in September, work was found to be actively under way at the mine, and it was stated that the branch railroad would be ready for business about November 1.

Mr. John H. Leavell is president and general manager of the new company, and Mr. Geo. O'Brien is mine superintendent. Office of the company, Stone Canyon P.O.

Seventy-five men were employed in cleaning out the old workings and getting things in shape both below and on the surface for a campaign of active production.

The mine, which has been described in various reports of this office and the United States Geological Survey, is undoubtedly the largest deposit of coal ever discovered in California. The vein easily averages fifteen feet in width, and it is estimated that there are between fifteen and twenty million tons of coal in sight. The working shaft is three hundred feet deep, and the seam has been developed by a winze reaching an additional three hundred feet in depth. Haulage underground and on the surface, as well as other power requirements, are by electricity generated in the company's plant, coal from the mine being used as fuel.

The former owners of the Stone Canyon mine expended a great deal of money in equipment and in building the railroad above mentioned, but the road was washed out by a cloudburst and much damage was done to other equipment just about the time they were to realize some return on their investment. This catastrophe overtook them about ten years ago, and up to this year no effort has been made to resume operations on a large scale.

The mine bunkers have a capacity of about one thousand tons of coal, and it is believed by the company that a daily production closely approaching that figure will be possible when alterations now under way have been completed. It is hoped to begin with an output of at least one hundred and fifty tons per day as soon as the transportation facilities are ready to receive shipments.

NATURAL GAS.

The bulk of the natural gas production of California comes from the counties included in the Bureau's Los Angeles Field Division; however, considerable amounts of this fuel occur in connection with petroleum in the Coalinga field, Fresno County. Practically all of it is consumed locally, either for lighting, for fuel under boilers or in operating gas engines. Aside from the above, production of gas in the San Francisco district is unimportant, being principally obtained in small quantities and used for domestic purposes at Stockton and Sacramento, as well as portions of Solano, Mendocino, Kings and Tulare counties.

PETROLEUM.

Fresno County is the only large producer of crude oil in this district, and that production is all obtained from the single field situated at Coalinga in the western portion of the county. The only other localities which have ever reported a commercial output are near Purissima in San Mateo County and the Moody Gulch and Sargent fields in Santa Clara County, in all of which districts the production is infinitesimal as compared with the total for the entire state.

Wild-catting has been prevailing in many of the counties throughout the district, although results of these activities have been negative in every case in so far as the Bureau is informed. According to a survey completed during the past year 'possible' oil land exists in limited

areas in Colusa, Yolo, Solano, Marin, Contra Costa, San Mateo, Santa Clara, Santa Cruz, Monterey, Stanislaus and Merced counties. 'Possible areas' are defined as all land on which there is the slightest indication of petroleum, but which remains unproved to date.

LOS ANGELES DISTRICT.

PETROLEUM AND NATURAL GAS.

The following comprise the producing oilfields in this district:

Devils Den—Kings and Kern counties.
Lost Hills—Kern County.
Belridge—Kern County.
McKittrick—Kern County.
Midway—Kern County.
Elk Hills—Kern County.
Sunset—Kern County.
Kern River—Kern County.
Arroyo Grande—San Luis Obispo County.
Santa Maria—Ventura County.
Ventura-Ojai—Ventura County.
Santa Paula-Sespe—Ventura County.
Piru, Simi, Newhall—Ventura County.
Salt Lake—Los Angeles County.
Whittier-Fullerton—Los Angeles and Orange counties.
Huntington Beach—Orange County.
Long Beach—Los Angeles County.

Approximately 85 per cent of the oil and close to 100 per cent of the natural gas produced in California comes from the above fields, and with the development of Huntington Beach and Signal Hill, the oil percentage will be even greater.

Briefly, the outstanding events of petroleum development for 1921 are as follows:

1. Huntington Beach developed into a field of prime importance. Though the first well was brought in as a producer in May, 1920, at the end of October, 1921, this field had 59 producing wells, 16 of which, however, were idle. The total daily production of the field was 16,500 barrels, the wells producing from a minimum of 50 barrels to a maximum of 2000 barrels daily.

2. Signal Hill, Long Beach, brought in its first producing well in June, 1921. This was drilled by the Shell Company, and known as Alamitos No. 1, producing 600 barrels of 23-degree gravity oil. Since then other wells have been brought into production and the future of the field looks bright.

3. In the Whittier-Fullerton field, at Santa Fe Springs, the Union Oil Company brought in their Bell No. 1, at a depth of 3700 feet, with a production of over 2000 barrels of 31-degree gravity oil. As a result, the productive area of this field has been much extended and drilling is proceeding at a feverish pace.

4. Last September the Chanslor-Canfield Midway Company brought in what is locally known as the 'Santa Fe' well, in the Redondo field,

at a depth of 3035 feet. The well has been deepened to 3100 feet and in December was reported as flowing at an increased rate. The bringing in of this well indicates the opening up of an entirely new field.

In another part of this bulletin will be found a detailed review of the petroleum industry of the entire state.

METALS.

REDDING DISTRICT.

Deposits of precious and base metals scattered throughout the eight counties constituting the Northern California Field Division have been a most potent factor affecting their early settlement and present development. This is particularly true of Shasta, Siskiyou and Trinity counties. Lumbering, stockraising and agriculture share the honors somewhat in Humboldt, Del Norte, Tehama, Lassen and Modoc counties. The district as a whole is predominantly a metal mining area, although in the five counties last mentioned the value of structural and industrial minerals occasionally exceeds that of the metallic.

The principal metals mined are copper, gold, platinum, silver and zinc. There has been little change in the copper situation during the year. One or two mines, like the Blue Ledge in Siskiyou County, which operated during 1920, added their names to the list of those already closed down, and it is expected that the copper production for this year will be even less than that recorded in 1920. The consensus of opinion seems to be that there will be little resumption of copper mining in the United States before the middle of 1922. The mines of this district are not included in the so-called 'low cost' group, and therefore probably face at least another year of inactivity, unless there is a marked improvement in the copper market.

The producing mines of Shasta County, the premier copper county of the district, are: the United States Smelting, Refining and Mining Company (Mammoth Smelter and Mammoth, Keystone and Sutro mines); First National Copper Company (Balaklala mines); Mountain Copper Company, Limited (Iron Mountain and Hornet mines); Pittsburg and Mount Shasta Mining Company (Little Nellie mine); and the Atascadero Mining Company (Greenhorn mine) on the west side of the Sacramento; and, on the east side, the Shasta Zinc and Copper Company (Bully Hill and Rising Star mines), and the Afterthought Mining Company (Afterthought mine) at Ingot.

A general wage reduction was made in the copper camps on February 1. Miners' wages were cut from $5 to $4.25 a day; muckers from $4.50 to $3.75; carpenters from $7 to $6, and plumbers from $8 to $6.50. Mechanics were reduced $1 per day and other labor in proportion.

Three companies, the Mammoth, Mountain Copper and Balaklala, asked for heavy reductions this year in assessed valuations for taxes, the aggregate reduction requested being $1,089,304. After hearings, the Mountain Copper Company was granted a reduction of $89,200 on its Iron Mountain mine. For the United States Smelting, Refining and Mining Company, the Mammoth group was reduced from $449,060 to $275,000 and the Sutro from $58,160 to $40,000; the Keystone remained

unchanged at $32,000. The Mammoth's improvements were also reduced $89,920. The assessed valuation of the Balaklala mine was cut from $262,160 to $175,000.

As an indication of comparative activity in copper mining during the past six years, it was shown at the hearings that the number of men employed by the United States Smelting, Refining and Mining Company was as follows:

In 1915, 899 men; 1916, 1002 men; 1917, 1141 men; 1918, 643 men; 1919, 506 men for five months, 128 for seven months; 1920, 96 men; 1921, 79 men for two months, 16 men for balance, mostly watchmen.

Judging from testimony given by the mine managers, it appears probable that the peak of copper production from the principal developed mines of Shasta County has been passed, and that the record production of over 39,000,000 pounds for 1916 may not again be reached, regardless of price.

Outstanding features of the gold mining industry during 1921 were the comparative improvement in Lassen and Modoc counties, particularly at Hayden Hill; increased activity in quartz mining in Siskiyou County, notably in the Salmon River district and near Callahan; capital investments and the reopening of a number of properties in Shasta County, in the French Gulch district; and the fairly steady production from the mines and dredges of Trinity County. Dredge operations in both Trinity and Shasta counties have remained nearer normal during the depression than any other form of gold mining. One new dredge is in course of construction in Trinity County and several possible dredging areas in Shasta and Siskiyou counties have been under investigation. The outlook for 1922 for this form of exploitation is good.

Hydraulic and placer mining, mainly confined to the drainage basins of the Klamath and Trinity rivers, shows little sign of improvement and there appears to be a strong trend toward quartz prospecting and quartz mining even in the heart of the alluvial mining area.

Lode mining gained impetus during the current year and more activity is looked for in 1922 than for the past five years.

The platinum group metals, which includes platinum, iridium, osmium and palladium, are produced mainly by the gold dredges in Shasta and Trinity counties. The high price of these metals in 1920 and the early part of 1921, however, stimulated platinum prospecting, and a number of individuals began producing. The principal 'diggings' were along Beegum Creek on the Shasta-Tehama county line, and on the lower South Fork of the Trinity River near Hyampom. The native metal in Beegum Creek assays from 13 per cent to 20 per cent platinum, and 75 per cent to 85 per cent osmiridium, and the high price of iridium made it possible, for a time, for some individuals to realize as much as $20 a day. There is a probability of machinery being put on Beegum Creek next year to handle the ground, and the production from this source will probably increase in 1922, although lower prices during the latter part of 1921 may discourage those who hold the poorer ground. The production for the year as a whole, from both dredges and individuals, should equal or slightly exceed that for 1920.

The production of silver as a by-product from the copper smelters will be negligible, but due to the stabilized price of silver under the Pitman Act a number of properties in the South Fork district of Shasta

County, where the lodes are primarily silver producing, are being developed and there has been a small production.

Zinc has replaced copper and assumed the major role in the metal production of the east belt with the completion of the new smelter of the Shasta Zinc and Copper Company at Winthrop. Metallic zinc is not produced, but a high-grade zinc oxide is obtained direct from the ore by the volatilization process employed, and the accompanying copper, silver and gold are recovered as by-products.

COPPER.

A number of copper prospects are being developed in Lassen County, among them the Red Rock mine, owned by Ben F. Logan of Westwood, and the Cooper Hill Copper Mining Company's property. A good road has been built to the latter, and camp boarding house, bunk house and other buildings erected. Native copper, oxides and sulphides are disseminated in diorite over an area 1400 x 4000 feet. The main adit is in 90 feet.

In the Diamond Mountain district, near Susanville, the Diamond Mountain Gold Copper Mining Company is developing the Victoria group of thirty-one claims. The deposit comprises a mineralized zone, marked by a heavy gossan, in quartz-hornblende-diorite. This deposit is about seven miles in an air line from the Engels Copper Mine in Plumas County.

The Corona Copper group, south of Honey Lake, in T. 26 N., R. 15 E., near the L. G. Stiles ranch, is another prospect on which considerable work has been done.

W. A. Miller of Fort Bidwell, Modoc County, owner of the Copper Blossom group of seven claims in the Warner Range, is developing. There is a dike on the property carrying azurite, malachite and native copper, in which he has a 400-foot tunnel and 80-foot shaft.

The Seitz, or Valley View group, on which assessment work is being done, adjoins.

One of the new prospects in Siskiyou County is the Liberty Bond group of eleven claims in the Happy Camp district, owned by F. B. McCann of Happy Camp. A ledge, in schist near a limestone contact, has been crosscut for sixty feet without reaching the wall. Assays are said to run 1 to 1½ per cent copper and about $7 in gold. Water power could be developed on Indian Creek.

Barnum Brothers are driving a tunnel on their copper prospect on the Klamath River just below Oak Bar. Air drills are used. The tunnel face is in 200 feet.

The Grey Eagle mine near Happy Camp, owned by the Mason Valley Mines Company of Nevada, has remained shut down. There are about one million tons of copper ore developed. Some prospecting was carried on by the company this year at a new deposit on Dillon Creek thirty miles southwest of Happy Camp.

The Blue Ledge mine in Siskiyou County was one of the last copper producers of the Northern California field to quit, it having continued to operate and ship until June, 1921. The building of their proposed power plant has been indefinitely postponed.

Copper prospects in Humboldt, Trinity and Shasta counties are generally dormant, but a thoroughly justified feeling exists that 'copper will come back' in due time.

The Mountain Copper Company drew its pumps from the Iron Mountain mine in March and closed this property for an indefinite period, transferring their headquarters to the Hornet mine. A little copper will be obtained from the mine water by precipitation. Shipments of pyritic ore from the Hornet have been curtailed, due to lessened demand. The company has nearly completed an aerial tram 13,329 feet in length with a drop of 1365 feet between terminals, to connect the Hornet mine with a new station, Mathewson, on the Southern Pacific Railroad. When this is completed the Iron Mountain Railroad will be abandoned. Trucks will transport such material as cannot be handled by the cable.

The Balaklala has been idle since the Mammoth smelter ceased operations. There is a large tonnage of ore blocked out. During the year the tramway from Coram to the mine was repaired and 1300 bales of scrap tin were transported from the railroad to the precipitation tanks, where cement copper, averaging about 30 per cent copper, is obtained from the mine water.

Twelve men were working at the Pittsburg and Mount Shasta Company's property early in 1921, but all work was suspended the last half-year.

The Atascadero Mining Company made a final payment of $50,000 on the Greenhorn mine near Tower House and also purchased the adjoining Great Western Copper and Gold group during the past year. The mine was idle.

On the east belt, construction of the Shasta Zinc and Copper Company's new reduction plant was completed in June, and production of copper matte and zinc oxide commenced. The plant consists essentially of roasters, storage bin, cooling system, reverberatory furnace and bag house. After about six weeks run it was temporarily shut down, as the zinc oxide produced was not quite pure enough or white enough to meet the market requirements, and it was found that a refining plant would have to be added. This is under construction. The smelter produces about thirty tons of zinc oxide a day, with copper matte, containing some gold and silver values, as a by-product. The zinc-copper-silver-gold ore comes from their Rising Star mine, where an immense tonnage is blocked out.

The Afterthought mine at Ingot has remained closed down. The ore at this mine contains from 14 per cent to 18 per cent of zinc, about 3 per cent copper, and small amounts of gold and silver. Since the drop in copper prices, it has been impossible to operate at a profit without saving the zinc values. A flotation plant, designed to save the several metals, proved a failure, and until a successful process is found no effort to produce will be made.

In January, after about three months work, drilling at the Shasta May Blossom group was stopped. It was reported that 170 feet was the greatest depth reached.

GOLD.

At Hayden Hill the Daisy Dean mine is being opened up by H. C. Watson of Hayward, California. Work was also begun at the Blue Bell, La Ora and other properties toward the latter part of the year. The

Juniper mine, which was taken over by the present company in 1918, has been opened to a depth of 387 feet, where the ore body is thirty or more feet in width, with very rich streaks in places. The gold is fine and free, and is not a constituent of the rock, but is found in the fine, clay-like and sandy portions of the consolidated rock breccia which composes the vein. The property is equipped with a 10-stamp mill and cyanide plant. In March the mill was shut down for alterations. A trommel with 1-inch holes and containing a series of seven or eight high-pressure adjustable washing sprays, was introduced between the mill ore-bin and stamps, and all material which does not pass through the 1-inch holes is sent direct to the dump. By discarding the coarse rock, after washing, the mill capacity has been greatly increased. Plates and carpets follow the stamps, and if desired the pulp is then sent to the cyanide plant. Five men are employed in the mine, and three in the mill.

In Modoc County, two properties were under development in the old camp of High Grade. At the Mountain Sheep mine a shaft is being put down by Broaddus and Reynolds of New Pine Creek, Oregon, and arrangements were under way to move the hoisting plant of the Big Four to the Mountain Sheep.

Maupin and Mathews of Fort Bidwell, owners of the Fort Bidwell Consolidated mine, are working three men. The lower tunnel is in 450 feet. It parallels a vein from which assays of from $12 to $52 have been obtained.

There was no activity in the Winters district.

Along the Klamath River from Hornbrook to the end of the road, now reaching 20 miles below Happy Camp, there was very little interest taken in gold mining, either placer or lode.

Charles Benback, owner of the McCook placer on Humbug Creek, is working alone. The McCook was a small producer in 1919 and 1920. A little ore has also been worked by other parties in arrastras along this and Keeler Gulch.

R. T. Hooper of San Francisco was prospecting the old Snowball placer mine, six miles below Oak Bar, with a view to working it. Farther down near Scotts Bar the Quartz Hill mine was idle. They will change the location of their workings. It is operated in the winter only, on account of lack of water.

The Roxbury mine has been leased to Hammer Brothers and is under the management of J. Milne. It is shut down. One man is working on the ditches. The company was drilling ground at Seiad Flat in 1920, but they did not complete the work.

The Mary Alma claim, owned by Carl T. Frey of Seiad, was being prospected by F. A. Sennet. It is a low bar worked to water level in the early days.

The Portuguese mine, owned by Henry Wood, is idle.

Wood Brothers, lessees of the Siskiyou Mines Company property, worked a little last winter, and the Davis hydraulic mine worked three to four men for five months.

W. G. Brown of Happy Camp, owner of the New Era, did assessment work. There are 480 acres of bench gravels in his holdings with ditches and giants.

Conditions at the hydraulic and placer mines along the Salmon River and its tributaries are little better.

The William Burns mine, near Sawyers Bar, was worked the past winter in a small way.

E. Curran, owner of the Whistle Bar mine, is constructing a 4000-foot flume from the North Fork of Salmon River, and expects to start work, October 1. There is 800 feet of old channel left. A. Jacquemart of San Francisco, is testing ground six miles below Sawyers Bar with intention of hydraulicking.

The Forks of Salmon River, the largest hydraulic mine in this district, has been idle since April. Work was started by the company in 1917, and continued until December 1920, when it was leased to E. T. Atkin who operated until April 1921. Freezing weather prevents work for from one month to six weeks in December and January.

There are no active mines at Forks of Salmon. The Bennett Company, which operated four mines up to 1918, shut down all work at that time.

Lorenz Bros. mine in Trinity County is the principal active hydraulic property in that county, and it will probably rank first in the Northern field in size of operations this year. A few small placers on Coffee Creek will add their quota to the county's output.

Most of the quartz properties reached from the Klamath River road are idle.

At the Nigger Boy, five miles southwest of Hornbrook, A. D. McCullough, who holds an option to purchase a three-quarter interest, was running a tunnel 200 feet below the lowest old workings, to cut the ledge. This tunnel was in 220 feet and machinery for air drilling was being installed. Four men are employed.

Several thousand dollars were expended on development at the Pilot Knob, three miles north of Gottville in 1920, but it was idle in 1921.

In the Oro Fino, Quartz Valley and Callahan districts, surrounding Scott Valley, there are signs of a revival in quartz mining.

The Mohegan, in Quartz Valley, is under lease to Kirk et al., and four men are working.

The Oro Grande or McKeen mine in the Callahan district, which was closed down in 1916, was taken under lease by F. W. Roueche of Salt Lake City, on August 15 and a small crew of men are cleaning it out preparatory to operating. It is well equipped with camp accomodations for fifty men, machinery, mill, etc. There are several miles of workings.

The Chapman mine has been acquired by the Metals Mining Corporation. A good road has been built to the property, camp buildings erected and a well equipped shop, laboratory and assay office erected. Ten men have been employed on development work since March.

The owners of the Porphyry Dike mine are putting a small ball mill on their property.

In the Salmon River country lode mining has picked up, and a number of properties are working on a small scale.

The Siskiyou Syndicate is opening up the Cub Bear mine, and at the Highland mine near by, five men are employed.

The Gilta on Knownothing Creek, is being operated by Headland and Silva.

D. Malloy owner of the Malloy mine, is working alone. There is a good three-stamp mill on this property.

Neilan and Putnam are operating a property on Counts Gulch.

There is a little work going on at the Black Bear, and ore from the dumps is being milled.

The California Consolidated or Golden Ball mine has been taken under lease and bond by F. A. Gowing and a new ten-stamp mill is being erected. Water power will be used. Fifteen men are employed. Some excellent ore has been opened up.

Gold production has shown less fluctuation in Trinity than in most of the other counties.

Three dredges, the one of the Valdor Dredging Company below Junction City, that of the Trinity Gold Dredging Company above Lewiston, and that of the Pacific Gold Dredging Company at Carrville, have remained in steady operation. The large dredge of the Estabrook Gold Dredging Company at Trinity Center which was shut down in October, 1920, was not operated in 1921, but preparations are being made to again place it in commission the coming spring.

L. Gardella of Oroville and Redding, began construction of a new dredge in June. It is located on the Trinity River two miles below Lewiston on the Paulson ranch, which was acquired for dredging purposes. Digging will begin early in 1922.

The Bonanza King, Enterprise, Fairview, Five Pines, Van Ness and several smaller lode mines have been in fairly active operation. Shortage of water for power has caused some loss of time.

The Midas mine at Harrison Gulch is idle. A good size vein has been developed at Layman Bros. mine near Hayfork and a new five-stamp mill was completed in November.

In the New River country the Index mine near Denny, is being opened up and equipped with air drills, a six-stamp mill and other machinery. There have also been a few small placer operations in the New River section. It is reached by trail only.

An option and bond was taken on the Golden Jubilee mine near Carrville in May and the Coffee Creek Mining Company organized to operate same. This company is also negotiating for the purchase of the Cleveland mine in the Bully Choop district.

Actual production of gold in Shasta County in 1921 will come largely from dredge operations, but quartz mining promises to furnish a larger proportion in 1922 than for some time past. The final time for completion of the 1920 assessment work was extended to July 1, 1921, and this work enlivened all the old districts.

In addition, development was resumed at the Central in the old Diggings district. The Reid mine, also in this district, was examined in October, by engineers representing the Tonopah Mining Company of Nevada, and arrangements made for unwatering and complete sampling.

The first stamps to drop in the county since the general closing of the mines during the war, were those of a two-stamp mill at Buckeye where two men are working a seam.

In the vicinity of Whiskeytown (Stella), Shasta, and Middletown, new claims have been located and old ones are again being developed.

The principal activity, however, is in the French Gulch district. Harry Thompson has opened up the old Niagara and is taking out good ore. Stamps began dropping in September. Thos. Salsbury has a lease on the Washington and it is again being worked. The Milkmaid is being operated by Capt. H. E. Smith.

The most important development is the reopening of the famous Gladstone mine, that has been idle since 1915. The mine was examined in July by Fred Searles, representing Montana and Idaho capital. It was taken over in August, the operating company being known as the French Gulch Gold Mining Company, Hamilton Eddy superintendent. A crew of twenty men are at work, and 7000 or 8000 feet of tunnels and old workings have been put in shape so that production can start. The same interests that have acquired the Gladstone are operating the Tightner mine in Sierra County, another famous producer.

Sniping is still practiced in the creeks and gulches in the winter season and mention should be made of a remarkable find in Shasta County in February of this year when Joseph Miller and John Stein picked up a nugget in Motion Creek, with a little quartz attached, that weighed 21 pound avoirdupois. It netted the owners $3,419.27 at the mint.

A substantial bonus could have been obtained at a private sale and the nugget preserved for exhibition purposes, and it is to be regretted that this was not done. The largest nugget ever found in the county was the Jarrard, picked up on Flat Creek in 1870. It weighed 34 pounds.

IRON ORE.

The Noble Electric Steel Company, Heroult, Shasta County, continued to supply high-grade magnetite carrying 65 per cent to 70 per cent iron to San Francisco Bay points and Los Angeles during 1921, this making their twelfth year of active operation. In 1920, besides their smaller regular shipments to foundries, this company furnished about 1500 tons of ore which entered into the fabrication of the steel towers for the power line from Pit River to Cottonwood, to the Pacific Coast Steel Company. They also shipped ten cars to the Washington Magnesite Company, Chewelah, Washington, where the ore was used in the manufacture of magnesite brick. Production for the current year will be somewhat less than in 1920. This is the largest active producing iron mine in the state.

LEAD.

The production of lead in 1921 will probably be very small. A few lots of silver-lead ore were shipped from the White Star mine, South Fork district near Igo, Shasta County, to the Selby Smelting and Lead Company, during the year.

MOLYBDENUM.

Deposits of molybdenite are known in Shasta and Trinity counties, but they have not been exploited. The Monarch mine, owned by R. H. Bailey, is a recent discovery, located on the headwaters of Willow Creek and Stuarts Fork of Trinity River near the Siskiyou-Trinity County line. Molybdenite and molybdite carrying high gold and silver values occur in a vein said to be 10 feet in width.

PLATINUM.

J. J. Turner, of Oakland, has recently taken up claims on the Hayfork of Trinity River, above Wildwood, and three men are at work. There is a good sized area here that can be worked on a large scale if the ground justifies it.

Among the individuals actively engaged in mining are:

	Post office	Stream
Shasta County—		
Lee Brown	Platina	Beegum Creek.
Lee Johnson	Platina	Beegum Creek.
Mike Malone	Platina	Beegum Creek.
Charles Gresham	Platina	Beegum Creek.
Louis Somers	Platina	Beegum Creek.
William Hitchcock	Platina	Beegum Creek.
D. F. Wood	Platina	Beegum Creek.
E. Duval	Platina	Beegum Creek.
Trinity County—		
Lynch Bros.	Hyampom	South Fork of Trinity River.
James B. Murphy	Forest Glen	Rattlesnake Creek.
S. Daniels	Forest Glen	Rattlesnake Creek.
C. C. Cooper	Douglas City	Browns Creek.
Charles Bennett	Douglas City	Browns Creek.

QUICKSILVER.

It is not likely that any quicksilver will be produced in this district the current year, but development work is being carried on at several of the mines.

The Goose Lake Gold Mining Company is opening up a quicksilver deposit in Modoc County three miles east of Willow ranch. The orebody is large and low-grade as a whole, but it contains rich streaks of cinnabar.

Four men were employed at the Great Northern (formerly the Herzog and Morgan) mine, in Siskiyou County, from September, 1920, to February, 1921, and 200 tons of ore were taken out. The mine is equipped with two D retorts of 800 pounds capacity each, but production will not be started under present market conditions.

SILVER.

The Igo Consolidated Mining Company, which was organized in 1920 and took over the Big Dyke Silver mine, adjoining the Chicago and Silver Falls in the South Fork district, Shasta County, discontinued work in 1921.

W. W. Robinson has a crew of men working at the Climax mine in the South Fork district, where a 500-foot shaft is being put down.

Development work was carried on at the Chicago and Silver Falls mine, by F. M. Archer, owner, until June, when it was bonded to Edmund Jussen et al., of San Francisco. An air compressor and other machinery was installed and camp accommodations for a large crew provided. Ten to twelve men were employed and the workings were advanced 130 feet, opening up some additional good ore. Owing to a disagreement, however, the bond was forfeited and the crew laid off in September. The owner has continued development on a reduced scale and exposed some very high-grade ore in the Buckley tunnel. The main adit is over 3000 feet in length.

The White Star, also in this district, is shipping an occasional lot of high-grade silver-lead ore to the Selby Smelting and Lead Company.

The Ballou and Continental mines are also being developed. The prospect for continued activity in the silver mines of this district is bright.

ZINC.

There is at present no production of spelter, or zinc concentrates in the district. The Shasta Zinc and Copper Company is the only company mining zinc ores, and these contain copper, silver and gold as well. After roasting, the ore is smelted in a reverberatory furnace with the addition of powdered coal, and the zinc removed by volatilization. The volatilized zinc is oxidized in the furnace flues and recovered and marketed as zinc oxide. The other metals in the charge are recovered in the usual way in the copper matte.

The successful operation of this process marks an important step in the metallurgy of the so-called 'complex' ores of the east belt.

AUBURN DISTRICT.

This district is preeminent because of its gold mines. Copper is next in importance, with a great variety of industrial and structural minerals as yet only partially prospected or exploited.

While a somewhat improved tone has been noted in the copper market during the closing months of 1921, there has not been sufficient improvement in price to aid the small producer, whose costs are high. Most of the small mines and prospects described in the Seventeenth Report of the State Mineralogist have made little progress during the year and many of them are at present closed. Plumas County now leads the rest of the state in copper production, and is at present making most of the state's output of that metal.

Gold mining is slowly recovering after several years depression. This is noticeable especially in quartz mining on the Mother Lode and in drift mining in the mountains. The year has been marked by resumption of work in the Argonaut, Kennedy, Fremont and Moore mines on the Mother Lode in Amador County; in the Clio, Harriman and Patterson mines on the same lode in Tuolumne County, and the prospecting of many smaller properties. With operating costs again approaching a point where the ores common to the Mother Lode are payable, it is only natural that interest in the possibilities of this great vein system should be increasing. With present or past producers with records of millions of dollars in each county along its course, it is still true that there are sections of this lode that have never been adequately prospected at depth. This is coming to be realized more clearly as we consider the recent successes in those Mother Lode mines that have reached depths of from 3000 to 4000 feet. Climate, elevation, accessibility, labor and power supply are favorable for year round operation all along this lode.

Next in importance to the main Mother Lode are the opportunities offered by the East Belt, a system of true fissure veins extending nearly parallel to that lode but at distances of from eight to fifteen miles east

of it. These veins traverse the mica schist of the Calaveras formation and the granodiorite. This belt passes by Tuolumne, Soulsbyville, Sheep Ranch, West Point and northward, and is marked at frequent intervals by many mines that have yielded a million dollars or more each, though worked as yet to only comparatively shallow depths. There has been a resumption of work this year along the entire East Belt, with optimistic reports coming from several old properties that have been reopened, and from many small mines and prospects.

Operations at Grass Valley have expanded during the year as the result of improved operating conditions and lower costs. The wage question has been settled again for the time being. Miners now receive $4.25 and muckers $3.75 a shift.

Prospecting for buried gravel channels on the upper Forest Hill Divide, and eastward to the Ralston Divide, in Placer County, has been active. Work of the same nature has been going on at Willow Valley and just north of Nevada City in Nevada County. The Mugwump mine just south of Forest in Sierra County has been producing during the last half of the year, and the usual seasonal work has been done elsewhere in Sierra County. Considerable interest has been roused by the year's developments in the Table Rock mine in Sierra County and in the small gravel mines lately opened at the upper end of Little Grass Valley in Plumas County, nine and a half miles north of La Porte.

Except at Grass Valley, little gold production has been made during the year in the quartz mines off the commonly recognized course of the Mother Lode and East Belt. While many meritorious properties lie in El Dorado, Placer, Yuba, Butte and Plumas counties, they are more or less scattered and have not attracted the attention that comes to those mines and prospects that lie near larger producing properties. The result is a slower resumption of work in these outlying districts. Numerous prospects and small mines have nevertheless been unwatered or prospected during the year, notably near Greenwood in El Dorado County, near Towle in Placer County, near Forbestown in Butte County, Clipper Mills in Yuba County and at Crescent Mills in Plumas County.

The dredgers operated on Yuba River by three large companies still keep Yuba County in the lead as a gold producing county, but with resumption of operations by the deep mines of Amador County, the latter should soon displace Yuba.

The outlook for next year is encouraging, especially as regards quartz mining. Labor and material costs are going down and labor is more plentiful and efficient, due to the return of experienced miners from other occupations. Another happy omen for the gold mines is the falling off of the speculative real estate and oil stock booms. There is already an indication that attention lately given to profit taking in these is turning to the mines. It is believed that 1922 will witness a steady expansion of gold mining.

The outlook for the copper mines is less definite, but if the price of copper goes a few cents higher, some of the larger mines in Calaveras and Plumas counties ought to be able to resume work.

COPPER.

Little field work was done among the copper mines during 1921. The few notes below indicate the progress being made at the principal producing copper mine in the state, which is operating in the northern part of Plumas County.

Engels Copper Mining Company. Development has gained during the year and the company claims to have a good deal more ore in sight than at the end of 1920. No. 7 level in the Engels mine, which is 722 feet deep and had just been started at the time of the last report, had reached a length of 1500 feet at the end of October, 1921. Three new stopes have been opened and five more are planned. This level is in ore for 700 feet (October, 1921). The main ore-body here shows about 40,000 square feet area; the 702 ore-body, south of the main fault, 6000 square feet. In the Superior mine about 1850 feet of development work has been done, including about 1000 feet of drifts in ore, but no sinking.

A new adit level, called No. 10, which is 480 feet below No. 7, has been started near the old smelter, 6500 feet north of the mill. It is estimated this will reach the Engels ore-body when 7500 feet in, and will be driven 500 feet in ore before raising. This adit had reached a length of 600 feet and was going forward at the rate of 360 feet a month at time of visit. It is 8 feet by 8 feet in the clear. A trolley will deliver ore from the portal of this tunnel to the mill, doing away with the aerial tram now in use.

This company produced 1,055,000 pounds of copper in August and 1,046,000 pounds in September. The ore runs from 2.12 per cent to 2.25 per cent copper and contains about $1 a ton in gold and silver.

Concentrate is stated to contain 29 per cent copper, and .075 ounce gold and 8.58 ounces silver per ton. Recovery averages about 86 per cent of the copper.

An increase in mill capacity of about 50 per cent is said to have resulted during the year from putting the crushing rolls in closed circuit with two trommels which return plus 1⅜-inch ore to the rolls. The mill in recent months has been handling about 900 tons a day. Improvements have also been made in the method of cleaning middling.

The company reports a decline of several cents a pound during the past year in the cost of production. The present wage scale is $4.50 for miners, $4 for muckers and $3.50 for surface laborers.

Prospecting has continued at the *Gruss mine* during the year and some production was made early in the summer from the initial operation of the mill.

The prospect adit at the *Snowstorm* claims has been continued without striking any important ore-body.

Trask and Coffer mine in the Moonlight district shipped a car of ore during the year.

GOLD.

Amador County.

The Argonaut mine at Jackson was unwatered by about the middle of April, and during that month twenty stamps were started on rock coming from repair work on the lower levels. Since then operations have gradually expanded to nearly normal. Amalgam said to have been

worth about $60,000, from the November clean-up, was stolen from the mill early in December.

Bunker Hill mine, near Drytown, has continued exploratory work on the lower levels, and has been forced to continue levying assessments during the year. For eleven years previous to 1916 this mine paid steadily.

Central Eureka mine, at Sutter Creek, has been in profitable operation throughout the year. Many improvements were planned for the year and have been partly carried out. These include installation of electric power for hoisting; straightening and repairing shaft and putting new T-rails in shaft; and erection of a new head-frame. The annual report for the year ending the middle of April, 1921, shows a production of $418,033, or over $11 a ton. Shaft sinking from the 3900-foot level was begun in September, and had reached a depth of 4194 feet (incline) by December 1. An option has been taken on the adjoining South Eureka mine, and prospect drifts from the lower levels of the Central Eureka are being extended into the South Eureka. This arrangement allows prospecting the South Eureka 1000 to 1400 feet below the deepest of the old workings, at comparatively low cost, as the Central Eureka levels had already been driven to the latter's south line.

Defender mine, on the south side of the county on the east belt, has been consolidated with the Lone Star property across the Mokelumne River in Calaveras County, by the West Point Consolidated Mines, Inc. It is being worked now on a small scale by lessees.

Fremont mine, near Drytown on the mother lode and north of the Treasure mine, has been unwatered during the year by Metals Exploration Company, and is being prospected.

Kennedy mine was unwatered by the end of June and the balance of the year has been spent in repairs to the shaft and lower levels.

Moore mine. Work of reopening this old mine, a mile south of Jackson, was begun in August by the Moore Mining Company of San Francisco. A head-frame has been built, electric hoist, pump and compressor installed, and unwatering and shaft timbering is under way. The old shaft is 500 feet deep, with levels every 100 feet.

Old Eureka mine, at Sutter Creek, was closed down in June after over 1500 feet of shaft sinking and several thousand feet of drifts and crosscuts on four levels had been driven. Diamond drilling also failed to locate any important bodies of ore. Considerable of the equipment was sold for use at the Moore mine.

Plymouth mine, at Plymouth, has continued mining and milling throughout the year. This work has been mainly on low grade ore, although smaller chutes of high grade ore are found from time to time, the latest reported being on the west vein, on the 3225 level.

PLACER MINING.

Little placer mining has been done in the county during recent years.

The Crocker Company has been preparing for two years past to hydraulic the old Elephant, China Hill and adjacent mines at and near the town of Volcano. The work included cleaning and repairing reservoirs and twenty-eight miles of old ditches. The pay gravel has a width

up to 1000 feet and depth of from six to twenty feet, and lies on mica schist and limestone bedrock. The company will be ready to start piping as soon as water is available.

Butte County.

There is little new development to record from this county during the year.

Daley Prospect, in Sec. 23, T. 19 N., R. 5 E., was being opened by W. P. Black & Co. of Sacramento during the summer. The property was not visited, but a shaft 30 feet deep and a tunnel 60 feet below the outcrop were said to show a vein 18 inches to two feet wide, from which a mill test of 12 tons was said to have yielded $30 a ton. The prospect is about one-half mile from the Oroville-Forbestown road.

Hazelton (Carlisle) mine is in Sec. 35, T. 20 N., R. 6 E., three miles north of Forbestown. F. A. Rose and C. Lilly planned some work this year, but the property was idle in October, with a watchman in charge. There is a shaft reaching a depth of about 200 feet below the river bed, and over 400 feet of drifts. A 10-stamp mill was formerly operated.

Lookout mine comprises three claims in Sec. 23, T. 20 N., R. 7 E., five miles by trail from Strawberry Valley, and in the canyon of South Fork of Feather River. B. J. Aydelott and son were working the claims during the summer.

A little work has been done at the *Phoenix* and *Wyandotte mines* during the summer. A small stamp mill and other equipment was to be put on the Wyandotte late in summer and the shaft was to be deepened. J. A. Coutts of San Francisco was in charge.

PLACER MINING.

Steifer Drift mine, three miles from Magalia, was opened during the year and a little gravel has been washed. The channel here is opened by a shaft and a steep incline, with a total depth of 508 feet. This had to be pumped out. The mine has its own electric power plant on the West Branch of Feather River. It has been worked at intervals since 1855, when it was known as the Pershbacker.

Lawrence Gardella was reported early in the summer to be planning dredging operations on Butte Creek on the Groves and Hanscomb ranches.

Calaveras County.

Angels Camp Deep Mining Co. put its mill in operation and ran for a few days, but the grade of rock crushed was said to have been disappointing. Financing for further operations was going on in November.

Bullion Hill Mining Co. (Washington mine). This mine is six miles north of Murphys in Sec. 20, T. 4 N., R. 14 E., and just west of Sheep Ranch road. It contains one full claim and a fraction, called Golden Bell and Middle Fraction. W. O. Crosby of Vallejo is president and Fred Walker of Sheep Ranch is superintendent of the mine and secretary of the company.

The present company started work July 27, 1921. An adit had previously been driven 1200 feet, giving 200 feet depth on the vein at the face. This adit followed the vein N. 70 degrees E. 800 feet, and vein

had previously been stoped to the surface for a length of 200 feet or more. This drift has been advanced 100 feet by the present company. There is also an old shaft 130 feet deep, 1000 feet from the tunnel portal, but this is said to be on a parallel vein to the north.

The vein is solid quartz and ribbon quartz and is three to six feet wide, occupying a strong fissure. Near the portal, a dike follows one wall or the other, as is common in many east belt mines. The country rock is mica schist with diorite porphyry dikes and probably underlaid by granodiorite. The ore contains free gold and as high as 10 per cent auriferous pyrite and galena, with reported traces of zinc, antimony and manganese.

Five 1150-pound stamps and two Frue vanners were in operation at time of visit, handling fifteen tons daily. The superintendent stated that ore milled from 89 feet of drifting, with only a few cars thrown out as waste, had yielded $14.75 a ton. Drifting will be continued on the main vein, and crosscuts will be driven north and south to prospect for parallel veins. Electric power is used. Mine equipment includes a 10-inch by 14-inch compressor, transformers, blacksmith shop, pump for raising mill water from Indian Creek, and numerous small motors.

Carlton mine is 1.8 miles from West Point. Wendell Phillips of West Point, part owner of the property, was working on it with two men during the fall. In November a ditch one-half mile long was being repaired and Phillips planned to take water from the Middle Fork of Mokelumne River for operating a compressor. The ground is being prospected by adits, the lower of which is 130 feet below the outcrop. The vein strikes north and has a maximum width of two and one-half feet.

Columbus mine adjoins the Lone Star mine on the southwest and is three miles from West Point. The claim has been prospected by several shallow shafts in the past. In November W. W. Gibson was employing a half dozen men. A crosscut had been driven 130 feet to a small fissure which had been followed nearly 300 feet, where the vein was encountered and drifted on for 60 feet. A raise put up 40 feet showed the vein four and one-half to five feet wide, composed of bluish quartz and heavily mineralized with sulphide of iron and copper. Drift was 125 feet below outcrop at face. Ore was being crushed in a Gibson mill and concentrate said to assay at times up to several hundred dollars a ton in value was being sacked for shipment.

Finnegan mine, on the northeast slope of Carson Hill, has been equipped with a 10-stamp mill and other machinery and put in operation early in the year by Lewis, Gilman and Moore. More regarding this and other mother lode mines will appear in a forthcoming report.

Good Luck mine is about three and one-half miles east of Railroad Flat by road, and contains three claims, covering 4500 feet along the strike of the vein. The owners, F. Lagomarsino, T. Scordalero, V. Valconesi, D. Bianchero and H. Sanguinetti, were mining and milling ore in November. The vein is opened by a crosscut adit and drift 550 feet long and 60 feet below the outcrop, and varies from a few inches to four feet in width. A 2-stamp mill and Handy concentrator were installed this summer and 70 tons of ore milled were said to have yielded $15 a ton.

Keltz mine and *Lone Star mine,* both in the West Point district, have been bonded by the West Point Consolidated Gold Mines Company, Incorporated, and have been prospected during the past year by the North Star Mines Company of Grass Valley. More details regarding these mines and others in the same district will appear in an early chapter of the next report.

Morgan mine has been in steady operation during the year, with mill capacity increased to 15,000 tons monthly. A reserve of medium grade ore sufficient for several years is now claimed for this mine. Further data on this and other mother lode mines will appear in a forthcoming report on that district.

Sheep Ranch mine. Montali Mine Syndicate, H. Robinson Plate, general manager, San Francisco; W. W. Logan, superintendent, Sheep Ranch.

The mine had previously been opened by three shafts, the deepest of which, called Sheep Ranch shaft, was down to 1350 feet, with a winze 200 feet deeper, when the mine was last worked, in 1907. At that time the 1300-foot level had been driven 1800 feet east and 800 feet west; 1400-foot level 900 feet east and 1550-foot level about 150 feet each way. The mine was considered stoped out to the 1000-foot level. Old stopes were filled.

The present company, during three years past, has unwatered and repaired the workings, has sunk the shaft to 1700 feet and has sunk a winze from 1300 to the 1700-foot level, 750 feet east of the shaft. A sub-level at 1400 feet has been driven 200 feet west and 250 feet east from this winze, the 1550-foot level has been driven 1100 feet east and 300 feet west of shaft, with ore in a series of lenses all the way; and the 1700-foot level has been driven the same distances. At time of visit in November, 1921, stoping from the 1400-foot sub-level had reached the 1300-level, stoping was going on from the 1550-level, and a stope had just been started from the 1700-level, all east of the shaft.

The vein is generally narrow, but swells to a width of three feet or more, and occupies a strongly defined fissure which strikes N. 55 degrees W. and dips 70 to 75 degrees northeast in hard, black, siliceous mica schist. Dikes of gabbro or diorite, probably connected with the large gabbro mass to the north, have crossed the vein. The hanging-wall shows loose slabs and lenses of graphitic schist, and the tendency of these to fall makes careful stoping necessary, for motives of economy as well as safety. A dike appears on the 1550 and 1700 levels east of shaft. The vein approaches this crossing on the footwall side of fissure on the 1550-level, narrows near the dike, and beyond it takes the hanging wall side of fissure.

The ore is quartz, sometimes bluish in color, and occurs in a series of irregular lenses that sometimes overlap. It is apt to change suddenly from medium to high grade or vice versa, and this condition increases the difficulties and uncertainties of operation. The continuity and richness of the vein, however, are indicated by the extent of the old workings, in which an average thickness of five feet was stoped for a maximum length of 1400 feet to a depth of 1300 feet, giving a reported yield of $4,000,000 from 400,000 tons of ore. The pay is principally in free gold. A mixture of various sulphides of iron, copper, lead and zinc, etc., are said to make up only one-half of one per cent of the ore.

Centrifugal pumps are used on the 850 and 1300-foot levels, and a Dean Triplex pump on the 1700-foot level handles about 125 gallons of water a minute to the 1300-foot level. A total of about 200 gallons per minute is pumped to the 300-foot level where it drains off through a tunnel 2400 feet long.

The present company started the mill December 24, 1920. Ore is hoisted to the headframe and dumped on grizzlies, where the coarse ore is sorted by two men, then crushed in a 12-inch by 15-inch rock breaker and trammed to the mill bins. Twenty 850-pound stamps dropping 104 times a minute crush the ore in solution and discharge at a height of three inches through a coarse punched screen. Pulp from the stamps is passed over Hungarian riffles to catch coarse gold and is then classified, the oversize going to a 5-foot by 16-foot tube mill in closed circuit, grinding to about 150 mesh. Entire product is cyanided. It is thickened in a 10-foot by 26-foot Dorr thickener to about 45 per cent solids. Solution from the thickener goes to clarifier, thence to gold tank and zinc boxes. Pulp goes to three Dorr agitators in series, and thence to four Dorr thickeners in series, which give a product about 70 per cent solids, and solution passes to clarifiers and to gold tank and zinc boxes for precipitation. A small part of solution from zinc boxes after precipitation of the gold is returned to the agitators to bring pulp to consistency of one to two but most of it goes to No. 4 thickener as a wash. A battery storage tank holds 125 tons of solution carrying .75 pound of cyanide per ton. About three and one-half pounds of lime and .9 pound of cyanide per ton of ore are used.

Mine equipment includes two air compressors with combined capacity of 1600 cubic feet free air, operated by 150-horsepower and 100-horsepower electric motors, and hoist with depth capacity of 2000 feet, operated by 200-horsepower motor. Water is obtained through seven miles of company's own ditch from San Antone Creek and electric power is bought from the Utica Mining Co. Of a total crew of 57 men employed in November, 1921, 38 were working underground and seven in the mill. Miners are paid $4.25, muckers $3.75 and batterymen $4.50 a shift.

Tollgate mine. (Port Arthur.) Tollgate Mining Company. This prospect is one-half mile south of Altaville. It contains one claim 1750 feet long and adjoining agricultural land on the strike of the vein, making 50 acres in all. There is a shaft 150 feet deep with levels at 100 and 150 feet, and 100 feet north of this another shaft 30 feet deep. There is about 50 feet of drift and crosscut on the 150-foot level. According to G. A. Ross, who is in charge, one hundred tons milled $7.50. This was from the 100-foot level near the shaft. There is a 3-stamp mill and one belt vanner on the property, which was idle when visited in November, 1921.

Blair mine. Triple Lode Mines Company, 68 Post street, San Francisco, Cal. This property is a mile and a half south of Altaville, near the Copperopolis road. There was an old shaft 450 feet deep when this company took the property. They have sunk a new shaft 250 feet deep, 800 feet north of the old one, and in the footwall. Crosscuts 300 feet long have been driven on the 150-foot and 250-foot levels, and drifts 60 feet on shaft vein on 150-foot level, 260 feet on

shaft vein on 250-foot level, 200 feet on east vein and 80 feet on another small vein on 250-foot level, but no ore is claimed to have been developed up to middle of November, 1921.

A twenty-stamp mill was moved from the old Hardenberg mine but has not been set up. Property is supplied with electric power and equipped with a 10-inch by 12-inch compressor, electrically operated pump, air-driven hoist and small buildings. A few men were working one shift in November and more work was awaiting further financing.

PLACER MINES.

Glenn mine. J. W. Glenn, owner, Mountain Ranch. This property, formerly called the Warren Ranch, is three miles north of Mountain Ranch in Sec. 31, T. 5 N., R. 13 E., and contains several gulches said to carry valuable gravel. It is planned to hydraulic these gulches during the present winter. The pay will run about 50 feet wide and six feet deep in the main gulch, judging from results had from a few prospect holes recently dug, and a little work done years ago.

A stone debris dam was being started the middle of November, about a mile and a half below the property. Water will be secured from O'Neill Creek through four miles of ditch.

Noce Placer mine, about five miles east of Mokelumne Hill, was operated by Frederick H. Rindge of Stockton for about three months last season with a 'dry land dredge.' Rindge has applied for a permit to hydraulic the ground this season. It is on Whiskey Slide Hill, and it is planned to impound the tailings in a gulch just below the mine. Property is equipped with electric power for pumping water. It has been worked in a small way in the past during rainy weather by the owner, John Noce.

El Dorado County.

Several small mines and prospects have been unwatered and examined in the Greenwood and Spanish Dry Diggings districts during the summer. A complete new report on the Mother Lode region of El Dorado and neighboring counties is in course of preparation, and this will deal with idle as well as active mines. Those noted below have either made some production or promise to begin producing soon.

Golden Unit mine formerly the *Argonaut,* is a mile southeast of Greenwood. Golden Unit Mining Company, Frank C. Fox, manager, Greenwood. Office, 305 Nicolaus Building, Sacramento. The company purchased the property this year and in July installed a Gibson mill with a nominal capacity of 10 tons a day. This was for the purpose of prospecting the quartz veins which outcrop on the claims, and which in the past have yielded some ore of pockety character. Besides the Argonaut patented lode claim, there are two unpatented placer claims and one unpatented lode claim. The claims are on the course of the west branch of the Mother Lode slates and greenstone.

Grit mine. Grit Gold Mining Company, Bryte Building, Sacramento. This property, which was described in our 1920 report, has been in steady operation during 1921. A 5-stamp mill and Deister concentrator, an 11-inch by 12-inch air compressor and an air hoist have been installed and water under 350-foot head has been brought in for power

and milling. The mill has been running since July 1, 1921, and can handle about fifteen tons a day when worked to full capacity. When last visited, the hoist was being erected over one of the winzes in the main tunnel, and this winze, which was down 28 feet, was to be deepened. Several satisfactory clean-ups have been reported since, and in October arrangements were being made to finance erection of five more stamps.

Havilah mine is at Nashville. In July a 5-stamp mill was put up and has been in operation since, crushing the dump, which is said to be yielding satisfactorily. There is material enough to keep such a mill going several years, as there is a shaft over 1200 feet deep and hundreds of feet of drifts at intervals of 100 feet in the property.

Pacific Channel mine (drift) is at Pacific on the Placerville and Lake Tahoe highway. Pay gravel was struck in this property early in the summer. When preparations were made for milling, difficulty arose over water supply and application was made to the State Railroad Commission to direct the water company to deliver needed water to the mine's ditch. After a long delay, during which the mine was shut down, it was found that a contract existed between the owners and lessees of the water supply, which stipulated that a certain amount of the water in the canal in question was for mining purposes, and an order was issued allotting the above mine the use of forty miner's inches of water one-third of the time.

Nevada County.

Allison Ranch mine, two and a half miles south of Grass Valley, was closed June 1, 1921. The last operators prospected the property quite thoroughly for new ore-bodies, but without success.

On No. 10 level, 1450 feet deep on the dip of vein, a crosscut was driven 1550 feet due west to the Hartery vein, a raise was put up 510 feet on that vein and drifts were run 700 feet south and 270 feet north on it without finding ore. On No. 6 level, crosscuts were run east 840 feet and west 640 feet without result. Levels except No. 6 down to and including No. 10 had previously been run out in most cases far enough to thoroughly prospect the mine. On No. 6 level, in the opinion of C. A. Brockington, the superintendent, the south drift had not been carried far enough to get under the Caribou ore-shoot, because of its rake as seen in the upper levels. The last work before closing was to drive No. 6 and No. 8 levels south past the Allison Ranch end-line into the New Idea claim, on which they had an option. Brockington claimed No. 6 level on this end showed $8.30 ore, according to mill runs made in May, 1921.

There had been about $800,000 spent on the mine and surface plant by this company according to Brockington. Nearly three-fourths of a total production of about $240,000 between July, 1917, and June, 1920, was made by tributers from ore mined on the south end of the mine between the 300 level and the surface. The tributers mined 23,141 tons worth $7.38 a ton and the owners mined 16,523 tons worth $3.87 a ton.

Alcalde mine. This mine has been in process of development during the year, with a few men employed underground. A winze is being sunk from the lowest level.

Empire mines at Grass Valley, reputed to be the second largest quartz gold producer in the state, has continued in full operation during the year. Late in the fall they were said to be resuming work through the Pennsylvania shaft. Operations at this property are carried on with great secrecy, so it is impossible to give any details.

Idaho-Maryland mines. The year has been spent by this company in completing the unwatering of the canyon shaft to about 2000 feet and in repair work and prospecting. Some ore has been milled from this work on the upper levels and prospecting of the lowest levels began in the fall.

Ironclad mine. The United American Mining Company has been at work on this prospect and late in summer had cleaned out a shallow shaft which they planned to sink to a depth of 100 feet.

North Star Mines Company has expanded the scale of operation since the making of the new wage agreement and were operating 50 stamps when visited in October. Costs and operating conditions have improved greatly during the year.

Normandie-Dulmaine mine. Late in summer work was resumed at this prospect, which lies just northeast of the Alcalde mine. Plans to sink the shaft were announced. A few men were employed at the end of September. Previous to that time, the present company had done little. There are some old shafts and cuts on the claims.

Red Ledge mine. This mine is on the Nevada City and Washington road, about two miles from Washington. The new lower tunnel and plant are at an elevation of 3250 feet. This is about 510 feet vertically below the apex at the road crossing. The new tunnel, which has been driven by a company during the past two years, is 1600 feet long, of which 300 feet is crosscut and 1300 feet on the vein. Although two of the small pay-shoots, which had yielded coarse crystallized gold specimens in the upper works, were struck in this tunnel and raises were put up 60 feet and 30 feet on them, no pockets had been found up to time of visit, September 28. The property is credited with a production of $45,000 in gold, some of it in beautifully crystalized specimen form, and 1000 tons of high grade chromite.

Equipment consists of drill sharpener, 3 air compressors, 75-horsepower semi-Diesel engine, Gibson mill of 10 tons capacity, small electric light plant, and gas engines of 4, 15 and 20 horsepower. The mine was idle in September.

Penn-California Mining Company (drift) has kept at work throughout the year on their claims at Willow Valley. A raise put up about 100 feet above the main tunnel struck gravel in July, but the bedrock was pitching and indicated they were on the rim.

Placer County.

American Bar Gold Mining Company has been prospecting the claims of the same name on the side of American River Canyon, south of Michigan Bluff, and had at last report two good faces of ore about 500 feet above the river. This mine was worked twenty-five years ago.

Drummond mine is three miles northwest of Baker Ranch. P. M. Brown has been working here since January, 1921. He has installed a ten-ton capacity Gibson mill, with which he has crushed a little ore.

Besides the old workings, Brown has prospected one vein for a distance of 500 feet on the strike, the greatest depth attained being 120 feet on a 40-degree angle, near the middle of this section, with shallow cuts and short drifts 200 feet north and 300 feet south of the shaft. He claims the ore tested was of good milling grade.

Garbe and de Maria mine is on Lady Canyon on the steep north side of the canyon of Middle Fork of American River. Two men were employed during the year in the search for the occasional pockets of coarse crystallized gold for which this mine is locally noted. The workings have not reached below the oxidized zone as yet, but consist of a network of crooked drifts on a flat seam, which dips east about fifteen degrees. This seam has produced a good many thousand dollars in beautiful crystals of gold which are in demand at much more than their bullion value for jewelry. The mine has been in operation for many years, but the operators seem at a loss to recognize any sure signs to show when they are approaching pay, and the gold is said to occur sometimes with the commonly recognized precipitants such as manganese oxides and iron oxides, and at other times without them; at times it is with quartz and at times almost free of it.

Langstaff and Storey (formerly Andy Farrier Diggings) were employing two men during the summer on the claim just north of the Garbe and de Maria mine, and possibly on the same seam system. Prospecting only was going on.

Oro Fina mine. Underground work at this mine in the Ophir district is being continued, but the mill has been in operation only part of the year.

Pioneer mine. A crew of about thirty-five men has been employed at this mine during the fall, and the mill has been in operation part of the time. Work lately has been on the Lynn vein. This mine is about two miles north of Damascus. Assessments have been levied for some time past.

Rawhide mine, on the south bank of the North Fork of American River, below Midas, was operated during the summer and fall, and the mill was run a short time, but expectations of developing a new shoot of ore were said to have been disappointed.

Rising Sun mine was in operation steadily until the last quarter of 1921. As stated in our last report, the mine was completely equipped and a new 10-stamp mill was put up during 1920. The mine was unwatered and was kept empty long enough to permit examination of the 800- and 900-foot levels, but no new ground was broken on these levels and during the summer the water was allowed to cover the 700-foot level. On the 300-foot level drifts were run 60 feet each way by the present company; on the 500-foot level, 60 feet east, and on the 600-foot level, 130 feet east and 480 feet west. A few thousand dollars were produced from the 600-foot level from ore said to average two to two and a half feet wide and to be worth $15 a ton. Preparations for sinking were being made in the fall, but have not been carried out.

The mine equipment includes a 100-horsepower Fulton hoist, capacity to depth of 3000 feet; air compressor, capacity 750 feet free air per minute; one mile 60,000-volt line and own transformers, electric motors

and pumps. The new sheet iron mill building houses ten 1100-pound stamps and two Deister tables, and there is a 12-inch by 16-inch rock breaker and a 24-inch link belt conveyor 110 feet long.

Snowbird mine. George McCullough and Lewis of Forest Hill, owners. Nevada-Pacific Exploration Company, lessee. It is in Sec. 21, T. 15 N., R 11 E., one mile from Sugar Pine mill and 32.5 miles from Auburn by road.

The lessee worked here over two years. A shaft was sunk nearly 300 feet on 60 degrees incline and levels were driven at 56, 134 and 285 feet depths. Two veins are claimed to exist, but there is very little quartz and the ore is mostly in talc zones in the serpentine. Veins are up to 3½ feet wide, strike northwest and dip 60 degrees northeast. On the 56-foot level, 100 feet was driven on the 'footwall vein,' 60 feet was crosscut and 50 feet was driven each way on 'hanging wall vein.' On 134-foot level drifts were run 110 feet northwest and 40 feet southeast on 'footwall vein,' a crosscut was run 140 feet and drift was run 190 feet southeast on 'hanging wall vein.' On 285-foot level a drift was run northwest 50 feet and southeast 30 feet on the footwall vein and a crosscut was run 90 feet. A length of 60 feet was stoped from 134-foot level to 56-foot level northwest of the shaft. About 400 tons in all were milled by this lessee. Ore had previously been taken out from the 56-foot level to the surface. The face of the southeast drift on the 285-foot level is said to assay well, but no definite ore reserve was claimed when the mine was visited in October, 1921. The property was closed down in November, 1921. The mine yields 3500 to 4000 gallons of water daily in summer.

Power is furnished by four horizontal boilers, fired by wood cut on the claim, and one 35-horsepower gas engine. There is a 35-horsepower hoist, a Cornish pump and a Cameron pump, two small air compressors, a boarding house, office and cabins. The mill contains a rock breaker, five light stamps, a 50-ton capacity ball mill, Atkins classifier, one slime table, two Trent cyanide machines and accessory equipment for cyanide treatment.

DRIFT MINES.

Blue Eyes prospect. Claims embraced in this group extend from Deep Canyon in Sec. 32, T. 15 N., R. 13 E., southerly to Duncan Canyon in Sec. 16, T. 14 N., R. 13 E., along the southerly and easterly slopes of a long andesite-capped ridge. The northern part of the property has an elevation of about 6000 feet. The present prospecting tunnel is near the south end of property at an elevation of about 4600 feet and one-half mile from the end of the road, which is passable for automobiles in the dry season. The camp is 57½ miles from Auburn.

When visited in July, 1921, the tunnel had been driven 1100 feet northwest into the lava in search of deep channels and the indications were that it had then passed over one channel. F. A. Moss, superintendent, was driving the tunnel ahead to pick up one or more of the smaller channels which he reasonably believes lie farther in the ridge. Several small hydraulic pits have been worked in the past on this slope of the ridge north and east of the line of the new tunnel and it seems certain that the channels worked in these pits must have traversed the

intervening distance in a general westerly and southerly direction. The property taken as a whole has great possibilities that have so far been hardly scratched.

Carmack Placer prospect. These claims were formerly called the Pacific Blue Lead mine and lie at the head of Big Secret Canyon near Canada Hill. Early in the summer of 1921 George Carmack took a Star drilling outfit to the claims and began drilling in search of a deep channel which probably crosses the property. Two holes were drilled without getting definite results. Drilling has been suspended for the winter but will be resumed in the spring. Several years ago the ground produced some gold from a remnant or bench of free white gravel which was cut off by a deeper and later channel that has not yet been bottomed. There remains a large and promising area not yet prospected where these two channels may be encountered.

Dixie Queen mine. This small mine is 500 feet above Duncan Canyon on the west side in Secs. 9, 16 and 17, T. 14 N., R. 13 E., and is reached by trail from the Pine Nut mine. Joseph Scherer, part owner, continues prospecting the channel. An area 200 feet long and 55 feet wide has been breasted above the tunnel, which is about 800 feet long, and follows the channel nearly southward.

Double O Mining Company. This company located a number of claims and did some work on the old mines at Deadwood during the past summer. A few hundred carloads of gravel washed during June and July, 1921, were said to have paid. Property was not visited.

Georgia Hill Gravel Mining Company, Incorporated. Office, 207 Thayer building, Oakland. J. F. Posert, general manager, Yankee Jims. This company has under option the old hydraulic and drift mines at Georgia Hill, adjoining Yankee Jims, and containing 757 acres in Secs. 32 and 33, T. 14 N., R. 10 E. A tunnel designed to bottom the channels has been driven 1400 feet, starting on the Trafton and entering the Kerr claim. This tunnel was driven south, and at a point 850 feet in was directly under the face of the old hydraulic pit and 175 feet vertically below the bedrock surface. Fifty feet from face of tunnel a raise was put up 206 feet and from the top of the raise an upper level was driven 22 feet south and 136 feet west. At time of visit, October 5, 1921, this upper level was entering ground carrying heavy granite boulders. The gravel beyond the old hydraulic pit passes under the andesite cap. The lower tunnel should give sufficient depth to bottom the ground, and the raise, being over 500 feet beyond the face of the old pit, will permit of exploratory drifts at various levels and in different directions.

The company has been working since July 1, 1919. Equipment consists of small gas engines, 8-inch by 9-inch air compressor, blower, blacksmith shop and small buildings.

Glenn mine. This mine is on the west side of Duncan Canyon, 54 miles from Auburn by road and is the only drift mine in that district that has been productive during the year. The mine is leased to the Tillotson Mining Company, F. Tillotson, superintendent, and part of the upper workings is subleased to Kendall. When visited, July 30, 1921, pay was being taken out from both upper and lower workings.

The lowest and last tunnel is one driven by the present company and starts 600 feet north of the south line of the Outlet claim. It struck

pay gravel almost directly below the portal of the Moss tunnel. Up to the time of visit this lower tunnel was 620 feet long and had followed the channel in pay for 150 feet. The gravel had been worked 12 to 15 feet wide. The gravel is mostly hard schist boulders with little quartz in it. It ranges from nothing to 2½ feet in thickness, being overlain by a coarse volcanic sand which in places closes directly down upon the hard polished schist bedrock. The gold is mostly in the crevices of the bedrock. The thinness or absence of the gravel and the coarseness and location of the gold are due to the steep grade of the old stream. This is plainly shown in the upper workings.

The upper workings consist of the Quigley tunnel, largely on the west rim, and about 1600 feet long and too high; and the Shields tunnel, which is 1800 feet long including a fork to the right. The portal of the Shields tunnel is 2350 feet north of the portal of the Tillotson tunnel, measured along the channel. The Shields portal is at an elevation of 5345 feet, which is 382 feet above the Tillotson portal. The face of the workings on the left fork of Shields tunnel is 140 feet higher than the portal, showing this steep rise in a distance of 1500 feet, along which there are many sheer drops of several feet, evidently waterfalls in the old channel, and not faults. The Moss crevice, 950 feet in the Shields tunnel, was 22 feet by 55 feet, and is said to have paid $9,000. Beginning 735 feet in this tunnel, pay gravel had been breasted for a length of 200 feet and up to 35 feet wide, to the time of visit, July 30, 1921. This breast was said to have yielded about $10,000 then. The lower workings are said to be continuing in good pay at this time (January 4, 1922).

Greek mine and Macedon mine adjoin, and are on the same deep channel, on Little Secret Canyon about one mile by trail from Secret House. Durfee and Durfee of Auburn have been working with a small crew steadily since last spring. The channel in its downstream course passes from the Greek into the Macedon. They are developing the latter claim as far downstream as the grade will permit, using the Greek Tunnel, and have not yet washed any gravel except for sampling, but the ground paid well in the Greek claim and it is presumed will prove valuable downstream.

Hard Climb mine is on the east side of Duncan Canyon, in the S.E. ¼ of Sec. 4 and adjoining part of Sec. 9, T. 14 N., R. 13 E., and accessible only by trail from the Glenn or adjoining mines. There are two tunnels 213 feet and 155 feet long, in gravel, and another driven too high. Chas. Arch, Clark Sullivan and W. T. Lundy bonded the property late in 1921, and Arch and Sullivan planned to spend the winter prospecting and sampling the gravel in sight.

Home Ticket mine is one of the former producers of the Last Chance district. There is an old working tunnel over 5000 feet long, from which the channel was extensively breasted. M. C. Threlkeld and W. T. Davis of Auburn leased the ground below this tunnel and from a point in the tunnel 4000 feet from the portal started a winze in search of a deeper channel. A crew of nine men was employed when visited, but work was suspended for the season in November, before the deeper channel was found. Davis intends to resume work in the spring.

Ralston mine. California-Hawaiian Development Company has continued prospecting during the past season but has not yet announced any results of particular interest.

Plumas County.

Crescent mine. Between 1917 and February, 1921, the Philadelphia Exploration Company did considerable new work at this old mine in the town of Crescent Mills. Electric power was put in and motors, compressor, hoist and pumps were installed. The mine was unwatered, then closed on account of the war, and later unwatered again. The shaft was sunk from the 400-foot level to 550-foot level. On the 550-foot level a fault zone 76 feet wide was encountered but the rock in it was too low grade to mine. On the 400-foot level and between there and the 200-foot level, a great deal of new work was done but results were disappointing according to the company's manager.

Green Mountain mine adjoins the Crescent and has been prospected lately by the Philadelphia Exploration Company with G. W. Worthington as manager. It was formerly worked by tunnels as deep as practicable. No. 6 tunnel, the deepest old entry, is about 1000 feet below the outcrop. This was reopened to the face, a length of 5080 feet, by the present company and at a point 3400 feet in a winze was sunk 500 feet on dip of vein, averaging 53 degrees south. Three levels were turned, at depths of 150, 300, and 450 feet. Stations 20 feet by 30 feet were cut on 150-foot and 450-foot levels, and on 300-foot level a sump drift 300 feet long was driven and bulkheaded for pumping. Drifts east and west on 150 and 450-foot levels have revealed the Green Mountain Vein striking north 70 degree west and dipping 53 degrees south, with an average width of 18 feet, but up to the time of visit, late in October, 1921, this vein had proven to be low grade. Work was done on the sulphide ore-shoot under the Lizzie claim.

The company owns its own power line one-half mile long from the Crescent mine to the Green Mountain portal, where the current is stepped down from 22,000 volts to 2200 volts and delivered to the winze in the tunnel by 3400 feet of lead-armored cable, and again stepped down to 440 volts for use in hoisting and pumping. There is also an air pipe line from the Crescent, and two air receivers, one in the tunnel and one on the 150-foot level, and pumps on each level. The mine yields about 120 gallons of water a minute.

Jamison mine. L. and J. N. Sobrero, S. Danelli and H. Hodgkins have been working this mine near Johnsville under lease since November, 1919, when the owning company quit. Fifteen stamps have been running two shifts a day. Ten men besides the lessees were employed in July, 1921.

Madra Mines Company 625 Market street, San Francisco. D. W. Shanks, president. During the summer of 1921 this company took options on the Arcadian, Pennsylvania, New York and other claims in the Greenville district. At the end of October, the Arcadian and Pennsylvania tunnels had been retimbered and a compressor and engine put in at the Arcadian. Six men were employed.

Plumas Eureka mine at Johnsville was reopened since the last report and 20 stamps were put in operation early in June, 1921. According to

Chas. D. Stark, Jr., superintendent, late work has developed an area of 67,500 square feet of stoping ground on the Mohawk flat vein which shows an average width of four to seven feet. This vein is opened through a raise 534 feet long from the Eureka Tunnel. Ore is said to run $8 to $9 a ton and to contain 3½ per cent of sulphides, principally pyrite and galena, and worth $68 a ton. This is the most extensively worked gold quartz mine in Plumas County.

Plumas Eureka Annex Company is a Reno, Nevada, stock company which has been doing some work on four claims on the west side of Mount Washington, southwest of the Plumas Eureka mine. When visited at the end of June, 1921, there were two prospect holes, one 10 feet deep, and the other, an old one, about 20 feet deep and about 275 feet apart on a quartz vein with a maximum width of five feet, striking north and dipping west. The vein is heavily charged with sulphides, pyrite and copper sulphides being most prominent. A short crosscut was being driven and a boarding house was being erected. The claims are nearly two miles south of Johnsville on the Gibsonville road.

Seneca Consolidated mine near Seneca was closed October 20, 1921.

Snowbound mine. C. M. Root put a five-stamp mill on this prospect late in the summer of 1921 but had run it only 30 hours up to October 22. The claim is about three miles east of Onion Valley.

Wheelock mine. Rock milled here during the past year in a two-stamp mill is said to have not paid. The claim is in the townsite of Crescent Mills.

PLACER MINES.

Marguerite Drift mine consists of 11 placer claims covering about 1100 acres in Secs. 13, 14, 23 and 24, T. 22 N., R. 9 E., on the headwaters of South Fork of Feather River at the head of Little Grass Valley.

John and Gilbert McFarlane did considerable prospecting here without getting definite results. They finally bought a Keystone drill outfit in 1919 and put down a series of 14 drill-holes, which gave them the location of the channel and when a shaft was put down on one of the drill-holes it was found to be nearly in the center of the pay gravel. This shaft is in the N.W. ¼ of the S.W. ¼ of Sec. 13. It is 183 feet deep, passing first through 50 feet of boulders and clay streaks, then 80 feet of pipe clay and finally through 53 feet of gravel. From the shaft they drove south 120 feet through gravel; from a point in this crosscut 70 feet from shaft they had drifted east 80 feet and west 50 feet at the time of the writer's visit late in October, 1921. The bedrock was rising near the shaft on the north, and at the faces of the south crosscut and east drift. They had less than 100 feet to go westward to the property line, but had already lost bedrock in this direction. The limited amount of gravel exposed at that time indicated that the course of the channel was about west at that place.

According to McFarlane Bros. the gravel taken out of these workings up to that time had yielded about $6,000. Estimating that about 400 cubic yards in place had been mined, this would indicate a return of $15

a cubic yard. They stated that the gravel paid for a width of 120 feet. It is fairly tight, most of the boulders being greenstone (amphibolite), with little quartz.

The mine is equipped with a 45-horsepower boiler fired by wood, a small hoist, pump, air compressor and receiver, two dump sheds, the largest of which is 25 feet by 45 feet, boarding house and two cottages. There is a good stand of pine timber for fuel and mine timbering. No regular outside water supply is at hand now but it is claimed that water can be had from the South Fork of Feather River through two miles of ditch and one-fourth mile of pipe. Melting snow gives a supply in the spring. The mine is said to yield about 32,000 gallons of water in 24 hours.

Maxine Mining Company is operating the claims formely called the *Dinsmore* or *Edgar mine*, which adjoins the Marguerite mine on the west. The two shafts are 672 feet apart on the same channel or its tributaries. The mine is 9.5 miles from La Porte and contains 960 acres of patented land in Secs. 11, 14, 22 and 23, T. 22 N., R. 9 E.

Like the Marguerite mine it was prospected by tunnels and shafts without success. In 1918 a Keystone drill was used to put down a series of 12 holes in a length of 1500 feet and the channel was located. The shaft that was later sunk proved to be not in the deepest part of the channel and is within 500 feet of the east line of the property. Work has been carried on at a disadvantage because of the shaft being on the rim. The shaft is 84 feet deep, passing through 44 feet of pipe clay which covers 40 feet of gravel. About 400 feet of drifting, practically all along the rim, in 1919 yielded $2,500, which was a good showing for rim gravel. Since then an attempt has been made to breast gravel west of the shaft, but the bedrock sinks here, and while the ground was said to pay well, work had to be stopped on account of water. Perhaps 300 to 400 cubic yards were breasted also on the west side of the north drift evidently on the rim, and this gravel is said to have paid about $2.50 a car. At time of visit, in October, 1921, they were running a drift southeast in gravel said to contain $10 a cubic yard. There were drifts north 250 feet and south 175 feet and some short crosscuts, but the property has not yet been properly opened nor has the exact course of the channel been revealed although it probably trended southward and westward.

The gravel is greenish gray, composed principally of boulders of hard amphibolite schist on bedrock of the same kind, and there are much heavier boulders than were seen in the Marguerite mine. Most of the gold is within two to four feet above bedrock. The mine is leased on 15 per cent royalty to the South Ford Gold Gravel Mining Company and subleased to Maxine Mining Company, of which John Burmeister is manager. It is equipped with a 30-horsepower steam boiler, fired by wood; 8-inch by 9-inch air compressor, Case steam engine, 10-horsepower steam hoist, cable conveyor for delivering the loaded bucket from the shaft to the washing yard, and boarding house and cabins. About 50 gallons of water a minute is pumped from the shaft. A nine months water supply with a minimum of 15 inches is claimed and is taken from the creek through one-half mile of pipe and ditch. There is a good stand of timber on the claims for all needs.

Work by the *Wood Estate Company* under the direction of J. F. Buell was being continued in October, 1921. Prospecting has been done at several places on the large acreage claimed. In the W. ½ of Sec. 18, T. 22 N., R. 9 E. the old Baker tunnel, 2200 feet long, in the Sweet Oil Diggings, was cleaned out but Buell reports that he found the old upper quartz channel cut off by a later channel. Work done some years ago near Buell's camp in Little Grass Valley included a shaft 80 feet deep, a drift 800 feet and an incline 33 feet. On drilling west and south of these workings the bedrock, according to Buell, was found to be 165 feet below the bottom of the shaft and the work was stopped. At time of visit he was drilling with a Keystone drill 4300 feet due west of the Maxine shaft, in search of the channel which he thinks runs from the Maxine westward.

Sierra County.

No field work has been done by the writer in Sierra County during the past year, as other members of the Bureau's staff were busy in the county a large part of the summer, visiting the placer mines in preparation for a new report.

Progress in quartz mining has been marked by the erection of a 10-stamp mill at the *Kate Hardy mine,* two miles southwest of Forest; the installation of more machinery at the *Sixteen to One mine* near Alleghany; the reopening of the *Rainbow mine* near Alleghany and the starting up of the mill at the *Tightner mine* at Alleghany late in the year.

The *Mugwump Drift mine* in the Alleghany district has been producing coarse gold and nuggets during the late summer and fall.

The *Table Rock mine* made considerable production during the past two years. At present the working tunnel is being extended to prepare for more breasting of gravel.

Tuolumne County.

Belmont Shawmut mine. Retimbering the shaft and other repair work was carried on during the summer while the management was waiting for conditions which would justify them in reopening. Since shutting down this company has been experimenting on a plan for treating the concentrate at the property.

Bonanza mine. Late in the year it was reported that this well known pocket mine at Sonora is to be reopened.

Buckhorn prospect. This is about three miles south of Jacksonville near Tuolumne River and adjoining the McCormick mine. In 1920 about 600 feet of dirft was driven on a vein striking east, which was thought to be one of the system of cross veins that cut across the main vein in the McCormick mine. No ore was developed and the prospect was idle in 1921.

Clio mine. Prospecting and development continued at this mine during the year. Work was in progress on the 600, 500 and 200-foot levels early in the summer. It was claimed that a block of low-grade ore had been proven between the 600-foot level and tunnel level and stock was being sold to finance the building of a new mill.

Experimental mine. Conlin Bros., Columbia, owners. This mine is on the south side of the canyon of the South Fork of Stanislaus River, a mile and a half north of Columbia by road.

The vein is a fissure filling of quartz, limestone and dike rock, with pay-shoots on the intersections of diorite porphyry dikes with the vein. The footwall is limestone and schist and the hanging wall is cavernous and broken limestone, full of water and mud holes.

The shaft is 400 feet deep on dip of vein, 45 degrees northeast. There are six levels and the vein has been drifted a maximum distance of 400 feet south and 170 feet north of shaft. The principal ore-shoot, 100 feet long and 2½ feet thick, has yielded $60,000. The richest ore on the upper levels carried free gold associated with azurite, but in depth there is also auriferous pyrite, galena and chalcopyrite besides the free gold. A crosscut tunnel 2800 feet long drains the water from the mine to within 75 feet of the bottom of the shaft; it lacks 300 feet of reaching the vein, but the drainage is effected through natural channels in the limestone. Though worked by lessees only in a small way lately, the mine is said to have paid better than all expenses for several years. There is a 5-stamp mill, air compressor and blower at the drain tunnel portal and a 3-stamp mill at the collar of shaft. Power is furnished by water bought from Pacific Gas and Electric Company. Another pay-shoot is thought by the owners to lie north of the present workings, as the surface there is said to have been rich placer ground in the early days.

Harriman prospect is a mile and a half south of Jacksonville, with the main road and the Tuolumne River passing the claims. The three locations are at a narrow place on the mother lode. When visited early last summer, there were two shafts, an old one 200 feet deep and a new one 130 feet deep, which are 400 feet apart. There are short drifts each way from the bottom of each shaft, and 116 feet of crosscut into the hanging wall from the new shaft. There are two veins, the Bull quartz vein of talc schist, rusty quartz and mariposite, and the Hanging Wall vein where the ore is found, in a stringer lead. The dump from the new shaft is said to assay $6.40 a ton or better.

Compressor and hoist are run by electric power. This and other mines on the mother lode will be discussed more in detail in a forthcoming report.

Mangante mine. E. H. Althoff and W. G. Busick were reported to have leased this mine at Jamestown in November, and to be preparing to sink the shaft, which was put down 150 feet several years ago.

McCormick mine. M. McCormick Company, owners. It is in Secs. 8 and 9, T. 1 S., R. 15 E., three and a half miles by road from Jacksonville on the steep north side of the canyon of Tuolumne River, two miles from the Hetch Hetchy Railroad. The main vein strikes northwest and dips southwest 50 degrees, filling a fissure in Calaveras schists. It is solid quartz, varying from 3 to 15 feet wide. The pay ore is mostly where minor veins and seams, striking east and dipping northeast, cross the main fissure.

The vein had been followed 1800 feet by an adit, which was about 600 feet below the apex of the vein at the face. A winze had also been put down 180 feet, following the vein below the adit and 1400 feet from the

portal. From the bottom of this winze the vein had been drifted on 120 feet each way at time of visit. Pay shoots had been stoped from a few feet to 100 feet in length along the adit and some stoping had been done along the winze between the adit and the bottom, but comparatively little above the adit.

A lower adit which is 500 feet below the main adit and 100 feet above the river, had been driven 300 feet but had not yet reached the main vein of quartz.

Ore is crushed in a Denver roller mill having a capacity of one ton an hour. The mine is supplied with electric power. There is an air hoist at the winze. The production for four years past is reported to have been $160,000.

National mine, near Priests, was being equipped early in the summer with a Huntington mill, rock breaker and gas engine, preparatory to milling ore. The mine had previously been equipped with a hoist, compressor and engine, and exploratory work had been going on a year or more. There is an adit about 500 feet long and other shorter workings.

Patterson mine. This old mine just north of Tuttletown, has been equipped with a 20-stamp mill, a hoist with a depth capacity of 2000 feet, compressor and buildings and is about ready for operation after an idleness of thirteen years.

The shaft was formerly sunk 820 feet and the vein had been stoped for a length of 500 feet and a depth of 450 feet. Recent development is said to have blocked out ore to the 750-foot level on the Patterson vein and some encouraging prospects are reported from the parallel Lennan vein where it has been crosscut. Adjoining claims on the northwest and east have been taken under option.

Pennsylvania and Carlotta mines, near the town of Tuolumne on the East Belt, were active again in the fall. Stoping and milling from the Carlotta began in August and at that time the adjoining Pennsylvania was being unwatered by the same company preparatory to deepening the shaft. Fred Vahrenkamp has a lease on the claims.

Rawhide mine. Frank Zuver of Oakland took a lease and option on this old property near Jamestown late in April, and when the mine was visited shortly after, M. H. Knowles was in charge of work. He had found what he claimed was a good prospect on the heavy quartz vein between the two old shafts and expected to sink on this.

United mines, on the East Belt two miles from Tuolumne, have been active during 1921. The Dead Horse shaft has been deepened and the vein was reported to show up well on the 1850-foot level late in the fall.

Prospective operations were promised at a number of other old quartz mines and prospects in the county during the summer. Among these are the *Contention mine* on Knight Creek, the *Phoenix* on the East Belt, four miles southeast of Columbia, and the *Excelsior*, near Confidence.

DRIFT MINES.

Monarch Drift mine, near Confidence, has been prospected during the year. In August rim gravel was encountered and an incline was being put down on it.

Sledge Drift mine, near Confidence, is to be worked this fall.

Springfield Tunnel and Development Company late in the fall had completed their drain tunnel to the point where good pay gravel had been struck several years ago. This prospect was obtained in a shaft which had to be abandoned on account of the water, and the drain tunnel was driven to permit working the ground.

Yuba County.

The *Horseshoe Quartz mine* is near Challenge, and is reached from the Marysville and La Porte road. Late in October, 1921, Joseph Supple of Portland, Oregon, was putting up a 5-stamp mill on the property.

The *Kingbird mine* is a mile northeast of Clipper Mills. Gil S. Peyton has a lease and option on it. In October, 1921, he was just completing a mill of five 1050-pound stamps near the Little Kingbird shaft.

The Little Kingbird vein on which he is working strikes north and dips east, varying from one foot to nine feet but averaging three feet in width. There is an old caved shaft which was sunk on the vein, to 125 feet. A tunnel 450 feet long is a crosscut for 350 feet and a drift on the vein for 100 feet, meeting the shaft at a depth of about 100 feet. Pay heretofore has come from the shaft and small stope and has been pockety.

DREDGERS.

Yuba County's leadership in the state as a gold producer for several years past has been due to the dredgers operated on Yuba River near Hammonton, Marigold and Parks Bar by Yuba Consolidated Goldfields, Marysville Dredging Company, and Pacific Gold Dredging Company, respectively. These operations have been covered in our recent Bulletin No. 85. Gold dredging operations on Yuba River have been on a larger scale than anywhere else in California and have yielded about $3,000,000 annually for eleven years past.

IRIDIUM AND PLATINUM.

Iridium and platinum are produced from gold dredging operations on Yuba, American and other rivers of the district, and occasionally by the drift mines, but there is no property that is worked separately for these metals. Iridium occurs usually alloyed with osmium as osmiridium. The platinum metals found in dredging on American River appear to contain more iridium than is obtained elsewhere in the district.

SILVER.

Silver is produced in this district almost entirely from gold and copper mining as a by-product of refining the metals and smelting the sulphide concentrates.

Engels Copper Mining Company, with a monthly silver production of 15,000 ounces or more at present, is the principal producer.

The mines of Alpine County at one time produced some silver but have been idle for a great many years.

SAN FRANCISCO DISTRICT.

Most of the metals are found to some extent in the San Francisco district, although primarily few of the counties in this group would be included in the list of our metal producers. This is explained by the fact that while they lie principally in the great central or coastal valleys, their limits, almost without exception, extend into the foothills of the mountainous and mineral-bearing regions.

The one metal in which this district does predominate is quicksilver. During recent years ninety-eight per cent of the entire production of the state has come from the hills of the Coast Range between the limits of Mendocino on the north and Monterey on the south.

Manganese is also found principally in the Coast Ranges, although the mining of this metal has receded to a position of insignificance since the cessation of the war demand.

COPPER.

The southern extremity of the so-called foothill copper belt traverses Madera, Mariposa and Fresno counties. Even in times of prosperity for the copper industry, the output from these districts was small. During the past year there was recorded the production of a little copper from Madera and Mariposa, and also a small amount from Mono County, which was included in some of the high-grade silver ores shipped principally from Benton to the smelters.

GOLD AND SILVER.

The gold and silver producers in this district are Fresno, Madera, Mariposa, Mono, Sacramento, San Joaquin and Stanislaus counties. As far as total value is concerned, the bulk of the yellow metal comes from dredgers operating near Folsom and Natoma in Sacramento County; east of Stockton in San Joaquin County, and at La Grange in Stanislaus County. Mariposa and Madera, as well as Mono, contain immense mineralized areas and are true mining counties in every sense of the word, but, as gold is their chief product, they have suffered with the rest of the gold mining industry of the country during recent years, when nothing could be done to offset high costs of equipment, supplies and labor, which they were forced to meet. It is interesting to note that conditions are becoming more encouraging as the year 1921 draws to a close and evidences are being given on every hand of the distinct revival of this branch of the mineral industry.

Probably the fact of greatest moment that can be recorded relative to gold mining in this district is the partition of the famous Mariposa Grant, which has for many years owned about forty-four thousand acres, containing the choicest mining land in Mariposa County. Fifty-six hundred acres, taking in fourteen separate sections in the southern portion of the grant, have been purchased by Messrs. T. E. Kelso and W. H. Holmes, both of whom were formerly connected with the Arizona Copper Company. These gentlemen are already reopening the famous Princeton mine and are laying plans for an active campaign of development and production. Included in their property, in addition to Princeton, are the Elizabeth, Alice, Mariposa and Long Mary mines, all of which have been big producers in the past.

The above-mentioned sale does not include the mines recently leased on the northern end of the grant near Bagby. This lease, which is for a period of three years, has been granted to Messrs. William T. Jones and W. F. Deaner, both well known along the Mother Lode for many years. Their lease includes the Pine Tree and Josephine properties and covers an area of approximately sixteen hundred acres. They contemplate the immediate erection of a 20-stamp mill.

Three gold mining properties have been actively operated in Mariposa County without interruption during the past year. These are the Mountain King with a 30-stamp mill, the Virginia Belmont with a 10-stamp mill, and the Original with a 10-stamp mill. It is understood that the Mountain King has been indefinitely closed down (December, 1921), but at the same time it is reported that the Virginia Belmont will double the capacity of their reduction plant. The latter property, which lies between Coulterville and Bagby, has a shoot of ore developed on the nine hundred level which averages at least three feet in width and which is said to plate from fifteen to forty dollars per ton.

Other activities in reference to quartz mining have been reported to the Bureau since it has become too late to verify them in the field, among which may be mentioned the reported reopening of the famous May Lundy mine in Mono County; a strike of bonanza ore in the Success mine in the Masonic district; the prosperous condition of the Golden Gate mine near the California-Nevada line above Coleville, Mono County; and the proposed rehabilitation of the Gambetta and Josephine mines in Madera County.

Dredge production in this district, taken particularly in Sacramento County, has been maintained at almost a normal rate and the LaGrange Gold Dredge Company launched a new boat at their property on December 18, 1921, near the town of LaGrange, Stanislaus County. This new dredger is being built for the company by the Yuba Manufacturing Company. It will have nine cubic-foot buckets, as compared to seven cubic feet, the capacity of the old dredge, which sunk February 1, 1921. The company only produced gold during the month of January, 1921, but it is hoped to operate continuously during the coming year. It is estimated by the company that about twelve million yards of gravel remain to be worked on their ground.

LEAD.

Very little lead is found in this district, the only production during the past year being recorded as a by-product from the gold and silver ores of Mariposa and Mono counties.

MANGANESE.

Manganese mining has been stagnant throughout the entire state during the past year. Its production was always small up to 1915 when the unprecedented war demands stimulated the development of manganese prospects to meet the condition temporarily established. Probably 75 per cent of this metal came from the San Francisco district, the several counties contributing to the output being Alameda, Lake, Mendocino, San Joaquin and Stanislaus.

QUICKSILVER.

As previously mentioned, the most important metal in the district being discussed has always been quicksilver. San Benito and Santa Clara counties alone contain mines which have more than equaled the production record of all the rest of the United States. Financial and economic conditions which have prevailed during the past year have brought this branch of mining practically to a standstill. It is estimated that the total output for 1921 will not exceed 2400 flasks—this, as compared with 10,000 flasks in 1920, 15,000 in 1919, 22,000 in 1918, and 24,000 in 1917. Never since records were first kept of the mining of this metal in California (in 1850) has the annual production been less than 10,000 flasks. It has often exceeded a figure as high as seven times that amount.

LOS ANGELES DISTRICT.

Copper, gold, iron, lead, manganese, molybdenum, quicksilver, silver, tungsten and zinc are the principal metals found in the southern part of the state.

With the exception of silver, never in the history of mining in California has there been so little activity. However, the last three months of this year have shown a marked awakening, as regards gold and silver mining in particular.

The high costs of labor and materials which prevailed during the war and after are now coming down to a basis which allows some margin of profit to the miner of low grade gold ores. If railroad rates could be reduced to approach the pre-war level, it would result in a wonderful revival of the mining industry. The railroads have promised a reduction in rates, but to what extent is unknown at present.

With reference to the 'war' minerals, manganese, molybdenum and tungsten, there is little hope for their mining and development at present.

Their importance and value were enhanced by the war and, with that passed, a comparatively small tonnage will furnish the needs of the commercial world, and only those deposits having low costs and transportation charges can hope to compete for the market which exists.

COPPER.

While copper has never been mined extensively in the southern part of the state, the war resulted in opening up many small high-grade veins. With the slump in the copper market, due to over-production, these were all forced to suspend operations, so that 1921 saw no activity in this metal. With the big copper surplus reduced, the large copper companies in the United States expect to resume partial production in the early part of 1922 and some revival in this district is anticipated during the coming year.

GOLD.

While it may not be common knowledge, gold was known to exist in Southern California many years before Marshall discovered the yellow metal on the American River. The early Mexicans not only worked the streams and gulches for placer, but also many quartz veins, and in the Piru region of Ventura County are seen old Mexican workings.

However, the Randsburg district has been the most important gold field in the southern section of the state, and its chief producer has been the Yellow Aster mine. During the last sixteen years this property has produced over $9,000,000 in gold bullion from approximately 2,500,000 tons of ore. The property is equipped with a 100-stamp mill and during 1921 thirty stamps have been in operation. This company contemplates resumption at full capacity the coming year. It has an immense tonnage of low grade ore, which can be mined by quarrying methods. By sorting out a small percentage of waste rock, it expects to have a mill head of $2.50 per ton and proposes to amalgamate at least $2 of this value. With cheap mining and low milling charges, the Yellow Aster, in 1922, should again take its place, not only as one of the large gold producers of California, but also, and more important, as a substantial dividend payer.

The Black Hawk mine is another in the Randsburg district which, in 1922, will again become a gold producer. At present, the mill is being remodeled on up-to-date lines and will soon be put in operation.

Many other properties in this district are being reopened, as well as having their plants remodeled, and 1922 should see much activity in the district as a whole.

In San Bernardino County, Bear Valley district, the Gold Mountain mine resumed operations in 1921 and shipped its first bullion during October.

During the year, the Tropico Mining and Milling Company, in the Mojave mining district, was leased by H. C. Burton and is now being operated by him.

The Exposed Treasure mine, Kern County, has been acquired by the Standard Gold Mining Company. The new company proposes to reopen the mines, remodel the mill, and introduce modern electrical power equipment. Thus, 1922 should see the Exposed Treasure once again in the ranks of the gold producers.

Vanderbilt District. In the extreme eastern part of San Bernardino County, near the Nevada line, lies the Vanderbilt district, the principal properties in which have been owned by the Campbell Estate till recently. The properties have now been acquired by the Vanderbilt Mining Company. The company intends to build a 100-ton milling plant in 1922. The ore is said to average $20 gold and five ounces silver per ton.

Last September, considerable excitement was caused by the reported discovery of gold in the Santa Monica Mountains near the Malibu Ranch. It was reported as found on the Kincaid-Decker Ranch. An investigation by the Bureau did not confirm the claims of the discoverers, however, as only traces of gold were found in the samples taken by the Bureau's engineer.

IRON.

During the year, a small tonnage of iron ore was shipped from the Armstrong and Doran Iron mine, eight miles northwest of Cadiz, San Bernardino County. This was sent to the Llewellyn Iron Works at Torrance.

There have been many rumors current during the year that some one of the large eastern steel interests proposed building a steel plant in Southern California. When investigated no confirmation of these rumors could be obtained.

LEAD.

There was but little activity in lead mining. The low price current during the year made it impossible for companies to operate at a profit. An instance of this is the Darwin Development Company, in Inyo County. After completing a new reduction plant they were forced to suspend operations, due to high costs of labor and supplies and low price of lead. It is possible this company may resume work the coming year.

QUICKSILVER.

The *Cuddeback Quicksilver mine,* in Kern County, three miles from Woodford Station, on the Southern Pacific Railroad, leased by John T. Bernard and associates, proposes starting operations the coming year.

SILVER.

On April 12, 1919, Hamp Williams discovered the so-called Kelly silver mine, about two miles east of Johannesburg, now known as the California Rand Silver, Incorporated. It was, however, during 1921, that its large production silenced the pessimists, and all agreed that it was a mine in every sense of the word, and not merely a bunch of high-grade silver ore.

The record of this property is phenomenal, it having produced, from April 12, 1919, to November 1, 1921, over $2,500,000 from 25,000 tons of ore shipped, and paid dividends amounting to over $1,000,000 in this period. This is exclusive of the Grady lease, which has also shipped over $1,000,000 in ore. And this came from a block of ground only 120′ x 120′ x 450′ in depth.

The California Rand Silver, Incorporated, completed and put in operation in December a 100-ton flotation mill, equipped with eighteen mineral separation cells for the treatment of its low grade silver ores, of which there are at least 100,000 tons, averaging 20 ounces of silver per ton ready for treatment.

When it is realized that 20 per cent of the gross output of $2,500,000, or $500,000, was paid for freight and treatment charges, according to the management, on 25,000 tons shipped, it can be readily understood why the company is anxious to treat its own ores.

The California Rand Silver, Incorporated, has now over 16,000 feet of development work. The property is opened up by three shafts, the deepest of which is close to 800 feet vertical, and has eleven levels.

It is capitalized for $1,280,000, of $1 share par value, and is under the efficient management of Mr. Meroney.

To the east of the California Rand Silver, Incorporated, lies the Coyote claim, owned by the Randsburg Silver Mining Company. Messrs. Kelly and Blanc, two of the largest stockholders in the Kelly mine, are the moving spirits in this property.

The property is well equipped for systematic development work, and is in charge of Mr. M. B. Parker.

It is developed by one vertical shaft 650 feet deep. Ore was first cut at a depth of 470 feet in the shaft. At a depth of 500 feet a crosscut was run southwest 540 feet, where it cut a four-foot vein, running north and south. Two samples cut across the vein in two-foot sections gave 147 and 60 ounces silver per ton. The company has now commenced shipping to the smelter.

Randsburg Mine, Incorporated. To the southwest of the Coyote claim are the holdings of this company, consisting of four claims. The property is well equipped for deep development. It has one vertical shaft, known as the "Bisbee," 588 feet deep. At a depth of 450 feet four feet of ore was cut, assaying 23 ounces silver per ton. R. R. Bray is manager of the property.

Elkins and Flynn. To the northeast of the Coyote claim is a group of claims being developed by Elkins and Flynn. Two diamond drill holes were put down on this ground in each of which it is claimed ore was cut before reaching a depth of 500 feet.

Miscellaneous. Besides the above mentioned properties, at least a dozen other properties are being developed by shafts and diamond drilling and the coming year should see intense activity in this new silver district.

There is only one element that may retard development and that is mining litigation, due to the 'apex' and 'extralateral' feature of our mining law. If wisdom prevails, however, the various contestants will settle their differences out of court, to the advantage of all concerned.

Calico Mining District. Several properties were worked on a small scale in this district. Reduced costs and dollar silver per ounce, guaranteed under the Pittman Act, allowed these to operate.

ZINC.

The Cerro Gordo Mines of Inyo County, the largest zinc producers, were not operated during the year.

STRUCTURAL MATERIALS.

REDDING DISTRICT.

The value of the structural materials produced in this district varies greatly from year to year in close concordance with the construction of highways, jetties and breakwaters, and general building operations.

In Del Norte, Humboldt, Tehama and Lassen counties the brick, tile and miscellaneous stone produced frequently surpass the metallic minerals in value.

Cement, chromite, granite, lime, marble and sandstone also come under this classification, and with the exception of cement, have been produced to a limited extent in the Northern California District. No changes of special significance were recorded in this branch of the industry during 1921, and aside from the crushed rock used on road construction, there was little activity.

Although there are no cement plants in the district, it is believed that sufficient favorable factors surround the immense limestone deposits

in Shasta County to warrant a special study of the opportunity they offer. Among these are: an almost inexhaustible supply of clean limestone, standing in an excellent position for economical quarrying; large shale deposits, easily mined, in close proximity; good plant site; water for power or other purpose, also hydro-electric power already available within three miles; a good market territory and transportation facilities, and cheap coal from local deposits which can be utilized direct in powdered form, or for the manufacture of producer gas.

BRICK AND CLAY.

Joseph Champion, Jr., and I. R. Wells of Dunsmuir, opened up a brickyard and engaged in burning several hundred thousand brick to supply the local demand. The quality is said to be good.

CHROMITE.

No chrome has been moving in this district during the year.

GRANITE.

'Black' granite, a variety valued for monumental and decorative purposes, was first reported as occurring in the district during the current year.

AUBURN DISTRICT.

The structural materials that are produced in the Auburn Field Division include brick and tile, chromite, granite, lime, marble, slate, and miscellaneous stone. Brick and tile and various other clay products used in building are produced at Lincoln, Placer County, on a large scale and fire brick is made near Ione, Amador County. Chromite was mined during the war in every county in the group, but during the past year has been produced from only one property near Towle, Placer County. The granite quarries at Penryn and Rocklin were extensively worked for nearly thirty years, beginning in the sixties, but during the year past have done little business, although they still have large reserves of good granite. Limestone and marble are abundant in the district. Limestone quarries have been most extensively operated in El Dorado County, and large deposits of black roofing slate are also found in that county. Tuolumne County has two flourishing marble quarries which turn out marble of various coloring, ranging from pure white to dark, and including a pink marble. The piles of old dredger tailings consisting of cobbles, at Oroville, offer a cheap source of crushed rock.

All these properties have been described in our past publications, to which the reader is referred.

CHROMITE.

Dan Sullivan of Alta, Placer County, has mined several carloads of high grade chromite during the year and has made a few sales. He has considerable ore mined ready for sale and more in sight in the mine. The property is located within a few hundred feet of a loading point on the Southern Pacific Railroad east of Towle. The ore shipped contained 50 per cent Cr_2O_3 or better.

SAN FRANCISCO DISTRICT.

BRICK.

Brick production in the San Francisco district for the past year was recorded as being from the following counties: Alameda, Contra Costa, Fresno, Marin, Sacramento, San Joaquin, Santa Clara, and Tulare. The industry is in a more prosperous condition than it has been for several years because of the fact that there has been so much renewed activity in building and construction work of all kinds.

CEMENT.

The year 1920 was probably the most prosperous ever experienced by the cement manufacturers, and while the value of the total output for 1921 will not show such a large figure, it is believed that this is due to the fact that costs of production were materially decreased during the past twelve months, thus allowing the selling price to take a big drop and assisting in bringing the general building program more nearly back to normal. Cement plants of large capacity are located in Contra Costa, San Benito, Santa Cruz and Solano counties.

CHROMITE.

Chromite is like manganese—one of the much talked of war minerals whose production sprang from little or nothing to many thousands of tons during the war period, and has again dropped back to its former position of unimportance. Chromite is found along the Coast Range mountains and also in the hills of the Sierra Nevadas in many of the counties of the San Francisco district, although last year production came from two only—Lake and Mendocino—and in both cases the amount was insignificant. The outlook for this branch of the industry can not be said to be bright, although there will always be a demand for high grade chrome in the chemical and allied trades.

GRANITE.

Granite is available at a great many points in the section of the state under consideration, probably the most famous granite quarries in the West being located at Raymond in Madera County. There has been little activity in the production of this material during the past year on account of various labor disputes. If that situation is cleared up, 1922 should record an increase in this business.

MAGNESITE.

Magnesite is one of the list of mineral products which are almost exclusively mined in the San Francisco Field District. The bulk of the state's production comes from Fresno, Napa, San Benito, Santa Clara, Sonoma, Stanislaus and Tulare counties. The past year has recorded a slump in the production of magnesite, but as the uses of this mineral are constantly increasing and becoming more diversified, it is believed that the future will bring good returns to those engaged in this branch of the mineral industry. One drawback to the magnesite found here, is that it is characteristically too pure to be satisfactory for refractory purposes. The foreign material, which supplies a great deal of the

demand for operators of steel, furnaces, etc., contains considerable iron, which is necessary in the construction of magnesite brick, furnace linings, etc.

LOS ANGELES DISTRICT.

In contrast to metal mining, those engaged in the mining of structural materials experienced abnormal prosperity during 1921. The almost absolute cessation of construction during the war resulted in an unusual demand for buildings, and the lowering of wages and materials which began in 1921, was immediately taken advantage of by the public. The building that resulted, in Los Angeles, in particular, and in all southern California, reached unprecedented figures.

The prospects for 1922 look exceedingly bright, and considerable expansion is contemplated by many concerns the coming year.

The continued growth of population in southern California augurs well for those engaged in the mining and manufacture of structural materials for the future.

ASPHALT AND BITUMINOUS ROCK.

This was mined in San Luis Obispo and Santa Barbara counties. The large program of road building in California has aided the mining of this material for dressing purposes.

What is known as the Sattler Asphalt mine, at Carpinteria, has been leased by Oklahoma parties, who propose the erection of a $100,000 refinery for the extraction of oil by a new process.

It may be of interest to know that years ago this property was owned by Wm. H. Crocker of San Francisco, who refined the asphalt for oil, until the discovery of the California oilfields proved too strong as a competitor of his oil products.

BRICK AND TILE.

Those engaged in the manufacture of brick and tile during 1921 had nothing to complain about. Prices were high and the demand exceeded the supply, and from all indications 1922 should be another exceedingly profitable year in this industry.

The Los Angeles Brick Company has purchased 600 acres of clay-bearing land adjacent to the Alberhill Coal and Clay Company, Alberhill, Riverside County, California.

CEMENT.

Cement plants ran to capacity during the year. The extensive use of concrete in buildings and highways promises to keep the plants busy for years to come.

Some companies are considering a program of expansion. Among these is the Monolith Plant, at Monolith, Kern County. This was formerly known as the Los Angeles Aqueduct Cement Plant and was acquired by the present company during the year from Los Angeles city.

The Monolith Company intend to increase their output from 1200 barrels daily capacity to 3000 barrels cement during 1922,

CHROMITE.

Shipments of chromite ore were practically suspended during the year from San Luis Obispo County, the main source of this material in the south. There is but little demand at present, and that at prices which make chromite mining unprofitable.

GRANITE.

There was little done in the quarrying of granite, though both Riverside and San Diego counties have granite of exceptional qualities for building and monumental purposes.

The cheaper cost of concrete and ornamental brick and tile, as compared with granite, has hurt the granite industry.

LIME.

The Summit Lime Company, owning kilns at Tehachapi, operated during the year.

MAGNESITE.

No activity in magnesite mining during the year, and prospects for 1922 poor.

MARBLE.

There are many varieties of marble to be found in southern California, especially in Inyo and San Diego counties. Many of these are suitable for construction and ornamental purposes. Alaskan, Eastern, French, and Italian marbles have heretofore been able to compete successfully with our local product. Cheap labor and water transportation has enabled these regions to undersell our marbles. We are, however, beginning to note a change. The building of our state highways with their laterals in all directions is working to the advantage of our marble deposits, and transportation costs are being reduced due to the use of auto trucks.

An increased volume of business is anticipated by the marble quarries in 1922.

MISCELLANEOUS STONE.

The crushed rock, sand and gravel business experienced wonderful prosperity, due to the tremendous building construction during the year, and the outlook for 1922 is exceedingly bright. Los Angeles County surpassed every other in the state in its output of crushed rock, gravel and sand, during the year 1921.

INDUSTRIAL MATERIALS.

REDDING DISTRICT.

At present the most important industrial mineral products of the district are pyrites and mineral water. This year marks the first commercial production of barite and Iceland spar in this field, and it is believed to be the first production of optical spar in the United States. New deposits of diatomaceous earth were located also, and their development commenced.

The hydro-electric power development under way in the northern counties seems to offer exceptional opportunities for the establishment of chemical and electro-chemical industries, the growth of which has increased greatly in this country since the war. The suggestion has been made by engineers that these industries could be established by the power companies themselves, or by subsidiary or independent companies and adapted to use electric power only at periods of minimum loading on the line so that a very cheap rate could be obtained. Compared to the East, but a small proportion of the electric power on the Pacific Coast has been used for industrial purposes. Such industries would be of great advantage to the power companies and at the same time they would produce a market for many of the raw mineral products which are abundant and in close proximity to the generating plants.

ASBESTOS.

The Trinity Asbestos Mining Company's affairs are in the courts. Suit was filed against the principal owners by H. H. Schmidt, for recovery of $131,512 which he alleged he invested. Judgment of $58,385.70 was awarded him. Several years ago the company built a fine road from Castella to their claims, near Carrville. This was taken over by the forest service. Everything else is abandoned.

W. S. Russell of Edgewood has located the Shasta View group of claims on Mount Eddy, in Sec. 8, T. 41 N., R. 5 W., on which chrysotile asbestos occurs in veins in serpentine. Some of the fiber reaches a length of one inch, but most of it is short. A ten-ton shipment was made in August, to the Paraffine Companies, Incorporated, of Emeryville, for experimental purposes.

BARYTES.

Austin Bros. of Oakland, have opened up a deposit of barytes, located in Sec. 29, T. 34 N., R. 3 W., near Copper City. A spur track runs from the Sacramento Valley and Eastern Railroad to the loading bins which are in turn connected by an aerial tram, one-half mile in length, to the deposit. A contract to supply 500 tons per month was recently entered into, the barytes going to Oakland for grinding.

The White Swan and Snowflake claims lie in Sec. 34, T. 35 N., R. 4 W. No work has been done on these, but where exposed the barytes is white, and has a maximum width of 15 feet.

ICELAND SPAR.

Iceland spar is the name given to pure crystallized calcite ($CaCO_3$) when it is sufficiently transparent and free from defects to be used for optical purposes. Heretofore this material has not been found in the United States with the exception of a small amount of doubtful quality at one point in Montana, and its production in Modoc County adds a new industrial material to California's output.

James D. and John Patterson of Cedarville have eight claims in the Warner Range near Cedarville, at various points in a belt five or six miles long. One claim was worked during the winter of 1920–1921, and about 1000 ounces were shipped to the Bosch and Lomb Optical Company. The price received was $8 per pound for pieces weighing one ounce, and fifty cents additional a pound for each one-fourth

ounce increase in weight of crystals. The largest crystal shipped weighed 12 ounces. The minimum size for first grade prisms is approximately ½ x ½ x 1½ inches for one shape, and ¾ x ¾ x ½ inch for the other shape, the true sizes being given in metric measurements. Crystals which exceed these dimensions in any direction were split down to the proper proportions before being weighed for purchase, so there was some loss in each shipment on this account. It is necessary to examine each crystal carefully for flaws by bright sunlight or electric light, as the least rainbow iridescence, incipient cracks or cloudiness causes rejection. Very careful handling is necessary to avoid injury. There is a large amount of material suitable for specimens, but the perfect crystals are only found where the vein swells and has left an open space which is filled with a claylike material in which a perfect crystal may be imbedded. The calcite veins, two to three feet in width, occur in a hard heavy rock, probably basalt.

INFUSORIAL AND DIATOMACEOUS EARTH.

An association of some 18 members, principally from Weed, among whom are C. O. Willis, R. P. Clark and W. E. Tebbe, have located the Insulator group of 39 claims with a total area of 5800 acres (later reported to be increased to 7000 acres) for diatomaceous earth. The deposit is 20 miles from Bartle, in T. 37 N., Rs. 2 and 3 E., along the new Pacific Gas and Electric Railroad, and covers an area one mile wide by 13 miles long. The ground is generally level, but it lies at an elevation of 4000 to 5000 feet, and can be operated only about seven months in the year. The deposit is of a bedded character and at least 300 feet in depth at one point. It costs $5 per ton to haul to Bartle. About five tons have been shipped as samples, 500 pounds being recently sent to New York for tests as to its value as a filler in the manufacture of paper. The association also has another prospect near Weed, two and one-half miles from the main line of the Southern Pacific Company, on which three men are working.

MICA.

Samples of mica (muscovite) in sheets up to two or three inches square, and probably of commercial value, have been received from H. Johnson of Sissons. The deposit is in Siskiyou County about 35 miles west of Yreka.

MINERAL WATER.

In the neighborhood of a half million gallons of mineral water are marketed yearly from this district, the principal production coming from Siskiyou County, where the famous Shasta Springs are located.

PYRITE.

Pyritic ore, 90 per cent of which averages 45 per cent sulphur, or better, and .7 per cent copper, is produced by the Mountain Copper Company, from the Hornet mine. The pyrite is used in the manufacture of sulphuric acid, and fertilizer. A portion is sold to the General Chemical Company and the Standard Oil Company. The latter company returns the pyrite cinder to the Mountain Copper Company's

Martinez plant where it is leached, and the copper recovered. Early in the year shipments averaged 15,000 tons per month, but the demand decreased and by May they had been reduced to 4000 tons monthly or about 150 tons per day.

AUBURN DISTRICT.

Chrysotile asbestos, barytes, pottery clay, limestone, mineral paint, silica, soapstone and talc have been produced in the counties of the Auburn Field Division.

Prospects of chrysotile asbestos have been found in several counties, but to date only one in Nevada County, near Washington, has been productive. Another in Calaveras County, near Copperopolis, is being prospected, and some work has also been started on a group of claims on the north side of American River, near Green Valley.

No barite has been mined during the year but a few cars mined in 1920 were sold.

Production of pottery clay and its products has continued at the properties named in our Preliminary Report No. 7 but aside from the resumption of normal operation at the plant of Gladding, McBean and Company, at Lincoln, Placer County, following the completion of their new buildings, there has been no increased activity noted.

A plant has been put up near Angels Camp, Calaveras County, for crushing and grading greenstone for industrial uses. It is described elsewhere in this report.

A company has been formed to open a limestone deposit near Sloat, Plumas County.

Some iron oxide ore has been shipped from Clipper Gap during the year for making paint. This was mined west of that place in Placer County.

ASBESTOS.

Pacific Asbestos Corporation, Belding building, Stockton. The property being exploited by this company is in the extreme southwestern end of the county, just north of Stanislaus River and five and a half miles from Chinese on the Sierra Railway. It has been prospected in a small way by tunnels and open cuts showing chrysotile fiber of fair length. A small experimental mill was put up which is said to have shown that the ore tested had an average content of 5.17 per cent asbestos fiber. Stock is being sold to finance the building of a larger mill.

Sierra Asbestos Company, Easton building, Thirteenth and Broadway, Oakland; E. R. Leach, president; R. E. Conrad, mine superintendent. The mine and mill being operated by this company two and a half miles northwest of Washington, and previously described by the writer, have been operated during the dry seasons for the past three years and many changes have been made in the mill.

Ore is still mined in the glory hole. A second pit has been started north of the first, but no ore has been taken from this. Both of these are connected by gravity trams with the receiving bin back of the mill. The mill heads are said to run 3 per cent to 5 per cent asbestos fiber.

At the receiving bin ore is broken in a rock breaker and sent by belt conveyor to the mill bins, which have a capacity of 150 tons. The three center stamps of each of four batteries crush the ore dry. A four-inch

air suction pipe is connected to each battery to draw off the dust. From the stamps the ore is taken by belt conveyor to the first shaking screen. Any fiber already separated from gangue is drawn off from the foot of this screen into a fiberizer, and thence by air suction into the first cyclone separator; then it passes over a double shaking screen, is picked up again by air suction and goes through a second cyclone separator and to the grading trommel.

Unseparated ore from the foot of the first screen is crushed in rolls 40 inches by 16 inches set one-sixteenth inch apart. Thence a bucket elevator returns it to the head of the first screen, which is divided longitudinally into halves, one for the stamp product and one for the roll product. The unfiberized roll product from the foot of this first screen, and also the unfiberized material which passes through the upper deck of the double screen but remains on the lower deck, pass to a burr mill. The burr mill product is lifted by a small bucket elevator to a third screen, from the foot of which an air lift picks up any fiber and delivers it to the cyclone separators.

Four grades, called Nos. 1 to 4, are produced and are sold for insulating purposes. The fiber is sacked and hauled in trucks to the railroad at Nevada City.

GREENSTONE.

Pacific Rock Granule Company is a copartnership between C. S. Renwick, T. H. Delap, E. Taylor, G. Rooker and L. J. Younce, all of Richmond, Cal. Office, Fourth and McDonald streets, Richmond.

A plant was built in October, 1920, just south of Angels Camp on the Tryon mine property, to prepare greenstone of various screen sizes. They call the product Angels Green. The plant has been in nearly steady operation. The rock, which is obtained from a short tunnel, is crushed to one-eighth inch in two rock breakers with a screen between them. From the second breaker the rock passes through rolls 27 inches by 14 inches, which gives a product sized 10-mesh to 40-mesh. This is elevated by a bucket elevator and graded on vibrating screens, the first one of 10-mesh, No. 17 wire, and the lower two of 28-mesh, No. 22 wire. Oversize from the coarser screen is returned to the rolls.

The product is of an attractive green color. There is a market for quarter-inch rock for use on hot tar roofing. Principal sales at present are to makers of ready roofing and artificial shingles. The rock for this use is rolled into the felt and becomes a component part of the product. The screen analysis for this purpose should preferably be as follows:

25 per cent to 50 per cent on 20-mesh.
25 per cent to 65 per cent on 40-mesh.
10 per cent on 60-mesh.
Not over 2 per cent, 80-mesh to dust.
No dust.

Dust is disposed of by the use of compressed air, after the crushing process.

There is said to be a market for the dust in making magnesite products, and there should be other uses for it as it is obtained here as a by-product incidental to the preparation of the coarser sizes, and it should be possible to sell it cheaper than from a regular fine grinding plant.

LIMESTONE.

The Plumas Lime and Rock Company. J. C. Reid, president. Office, 224 Forum Building, Sacramento. This stock company was formed to take over a fifteen-year lease given by Mrs. Elsie Reed Skemp to J. C. Reid on sixty acres of land in Secs. 1 and 12, T. 23 N., R. 11 E., near Sloat. The lease provides for the working of the deposit on a royalty basis.

The limestone is of good grade, analyses showing 95 per cent to 98 per cent calcium carbonate. It is two miles from the Western Pacific Railway. The company has had estimates made to cover the construction of a spur track, building of a kiln, etc. It is proposed to produce lime and limestone for agricultural and industrial uses.

SAN FRANCISCO DISTRICT.

The industrial materials are, with a few exceptions, produced on a comparatively small scale as yet in the counties which comprise the San Francisco Field Division. The possibilities of development along several of these lines are large, however, and with increasing transportation and other facilities, together with steadily growing demands, the future for this branch of the mineral industry throughout the entire state is most promising.

ASBESTOS.

Asbestos of good quality has been found in Fresno and Lake counties, although actual production in the past has been only nominal. During the fall of 1921 the Liberty Asbestos Company opened up a deposit of chrysotile near Coalinga and have already shipped several carloads to the test mill which they have constructed in South San Francisco. R. R. Norton, 641 Mills Building, San Francisco, is president of this corporation.

CLAY.

The principal counties in this portion of the state which contain developed deposits of clay suitable for commercial uses are Alameda, Contra Costa and Santa Clara. For many years earthenware articles and lower grade pottery products have been manufactured on a considerable scale. One of the most interesting developments of the clay industry recorded on the Pacific Coast is the construction of a plant by the Homer-Knowles Pottery Company near Santa Clara, for the purpose of manufacturing hotel and dinnerware crockery. When this company starts operations, as they plan to do early in 1922, it will be the first time that pottery of this character has ever been produced from crude materials mined west of the Rocky Mountains.

DOLOMITE.

Monterey and San Benito counties produced two-thirds of the dolomite mined in California. This material is coming into wider and wider use, the major portion of the tonnage shipped being utilized as a refractory lining in the bottoms of open hearth steel furnaces.

MINERAL PAINT.

While deposits of ochre and substances suitable for use as pigments are known to occur in a great many localities in California, commercial production of mineral paints is relatively small. The principal output comes from deposits at Knights Ferry, Stanislaus County. An interesting development in this branch of the mineral industry is the recently completed plant of the Ferro Products Corporation at San Andreas Beach, between Santa Cruz and Watsonville. Mr. D. M. Crist is manager of this company, Box 884, R. F. D. No. 3, Watsonville. The company's operations at the present time consist of calcining the black sands, which are obtained from the beach, and manufacturing iron oxide pigments of various colors.

MINERAL WATER.

Mineral waters are being bottled and placed on the market from almost all of the Coast Range counties in the San Francisco district. Lake, Mendocino and the surrounding region are said to contain mineral waters equal in variety and medicinal value to any of the famous health resorts of Europe. It is believed that great possibilities exist here for future development.

LOS ANGELES DISTRICT.

Asbestos, barytes, clay, dolomite, feldspar, fluorspar, fullers earth, gems, graphite, gypsum, infusorial or diatomaceous earth, limestone, lithia, mineral paint, mineral water, pumice or volcanic ash, pyrite, silica (sand and quartz), soapstone and talc, and strontium, have been arbitrarily classified under the above heading. These are all found in this district. With the exception of three or four of them, they are mined in comparatively small quantities. The rapid growth of population in the southern part of the state and the Pacific Coast in general has created a larger market for many of these industrials and much more attention is now being devoted to their development and exploitation. The public in general does not realize the potential wealth which this wide range of industrial materials represents.

BARYTES.

Both Los Angeles and San Bernardino counties have deposits of this mineral. Practically no production during the year.

CLAY.

Clay was mined in large quantities for the potteries, and these ran to full capacity. The outlook for 1922 is exceedingly bright.

DOLOMITE.

A small amount of this mineral was mined during the year in Inyo County, near Keeler. This was shipped to the soda plants at Owens Lake where the dolomite is used for generating carbon dioxide.

FELDSPAR.

A small tonnage was mined in Riverside and San Diego counties during the year. This material is becoming of increasing importance, due to the demand of the pottery manufacturers.

The Pacific Porcelain Ware Company of San Francisco contemplates building a 75-ton feldspar plant on its property in San Diego County, the early part of 1922.

FLUORSPAR.

This is being shipped at present from the Massen fluorspar deposit in San Bernardino County. It is located three miles southeast from Afton, a station on the Salt Lake Railroad, in the Cave Canyon mining district.

FULLERS EARTH.

The largest user of this material was the Standard Oil Company, who have a deposit in San Bernardino County, at Soclay, on the Tonopah and Tidewater Railroad.

Work was suspended on mining this material during the year, but may be resumed in 1922.

GEMS.

These are found in San Bernardino and San Diego counties, but the production during the year was insignificant, there being only a local demand.

GRAPHITE.

Practically no mining of graphite during 1921. Deposits of this mineral are know to exist in Imperial, Los Angeles, San Bernardino and San Diego counties.

The coming year, however, should see considerable activity, as the following companies contemplate operating their graphite plants.

Los Angeles Graphite Company. Deposit located on Kagel Canyon, eight miles east of San Fernando, Los Angeles County. The company has just completed a 100-ton graphite plant, and will be in full operation the coming year. Maintains offices at 211 Grant Building, Los Angeles. Albert Maltman, general manager.

California Graphite Company. This company has two groups of claims 18 miles northeast of Saugus, in a branch of the San Francisquito Canyon. Property is equipped with a 50-ton concentrating plant, which ran at intervals during the year. The coming year should see continuous operation of this plant. Offices at 402 Bryson Building, Los Angeles. O. M. Souden, president.

GYPSUM.

While deposits of gypsum are found in Los Angeles, Orange, San Bernardino, Santa Barbara, Ventura and Imperial counties, only a few deposits have a sufficient purity and such transportation facilities as allow them to be economically exploited. The greatest tonnage during the year came from the deposits at Amboy and those near Blythe.

The increasing demand for gypsum products, to be used both as a fertilizer and for building purposes has induced others to enter the field and two large companies will probably be among the producers in 1922.

Imperial Gypsum and Oil Company. This company has 400 acres of patented gypsum land, in Sec. 29, T. 13 S., R. 9 E., S. B. M., in the Imperial Valley, Imperial County. It is said to have an immense tonnage, analyzing 97.7 per cent gypsum. It is now constructing a 25-mile railway from the deposit to a station called 'Maria' on the San Diego and Arizona Railroad, and will commence the construction of a 500-ton gypsum plant during next January. The company proposes to enter the field, not only for the Pacific Coast business, but also will compete for the trade of the Orient, Australia and New Zealand. The company has offices at 250 Spreckels Building, San Diego. W. H. Coons is president and S. W. Dunaway, general manager.

California Gypsum Corporation. This corporation has large holdings in T. 13 and 14 S., R. 9 E., S. B. M., in the Imperial Valley, Imperial County.

Has an immense tonnage of better than 97 per cent gypsum. Proposes building railroad from deposit to San Diego and Arizona Railroad, a distance of 16 miles, also a large gypsum plant during the coming year. Will also compete for the markets of the Pacific Coast, Orient, Australia and New Zealand. Main office, 321 Central Building, Los Angeles. President, C. F. Guthridge.

INFUSORIAL OR DIATOMACEOUS EARTH.

As in the past year, the Celite Products Company, with deposits near Lompoc, Santa Barbara County, was the largest producer during 1921. From a small production a few years ago, this company has developed an immense business in diatomaceous earth products, and 1922 will see even a larger volume of business than in the past years.

LIMESTONE.

Large tonnages mined in connection with the cement industry.

The Monolith Company during the year acquired the Jameson limestone deposit at Monolith, Kern County.

PUMICE.

Small quantities mined in Imperial and Inyo counties during the year.

SILICA.

There is an increasing demand for silica, especially with the establishment of glass works in the southern part of the state. The competition of Belgian sand, brought as ballast by steamers, has retarded the development of silica mining. There is no doubt that the industry should be protected by tariff legislation.

The Southern California Marble and Development Company has a large deposit seven miles north of Coyote Wells, a station on the San Diego and Arizona Railroad, in Imperial County. It proposes to install much new equipment, such as aerial tramways, etc., for handling the tonnage more economically, during the coming year.

TALC.

Talc was mined from deposits in Inyo, Los Angeles and San Bernardino counties.

The largest production came from the Acme Talc mine, in San Bernardino County, seven miles east of Acme Siding on the Tonopah and Tidewater Railroad.

STRONTIUM.

Deposits occur both in Imperial and San Bernardino counties.

Occurs mainly as celestite ($SrSO_4$).

Comparatively a small tonnage was mined during the year. If the beet sugar people can be induced to use strontium minerals in place of lime, there will undoubtedly be a good future for strontium minerals. In both Germany and Russia strontium is largely used in the beet sugar industry.

SALINES.

REDDING DISTRICT.

Borax was first discovered in California in January, 1856, in the waters of Tuscan Springs, Tehama County, and salt and potash have been produced in Lassen, Modoc and Siskiyou counties. There was no activity in the mining of salines in 1921.

POTASH.

The reported discovery of potash in wells sunk along the shore of Honey Lake, the waters of which were said to contain from 4 to 40 per cent of the salt, turned out to be a hoax. An association, called the Desert Products Company, of which Dr. C. A. Jacobson of the Mackey School of Mines in Reno, was a principal, was formed to exploit the find, and some money was spent in prospecting and acquiring acreage, before it was discovered that the samples sent for analysis had been tampered with.

Nothing was done during the year, with the potash-bearing rock found near Ager, Siskiyou County.

AUBURN DISTRICT.

There is no production of any of the commercial salines in the counties of the Auburn Field Division.

SAN FRANCISCO DISTRICT.

About eighty per cent of the salt production in California is derived from plants in Alameda and San Mateo counties, where the water of San Francisco Bay is evaporated. This is the principal saline mineral produced in the San Francisco district, although some potash is being recovered from the flue dust of the Santa Cruz Portland Cement Company at Davenport, Santa Cruz County, and small quantities of magnesium compounds have been manufactured as a by-product by the Oliver Chemical Company in Alameda County, and the Whitney Chemical Company in San Mateo County.

The output of salt in this district is a well established industry and will undoubtedly continue to grow in the future at the same steady rate that it has developed in the past.

LOS ANGELES DISTRICT.

The lake beds of Inyo, Imperial, Kern, Los Angeles, San Bernardino and San Luis Obispo contain immense quantities of salines, and we are gradually awakening to their immense value.

Many of the products which are manufactured from these salts need some tariff protection and it is only right and just that these should be protected by sufficient tariff legislation until they have emerged from infancy to full growth.

With the exception of the years 1918 and 1919, borax has exceeded all other salines in value.

During 1918 and 1919 potash took the lead, due to its tremendous increase in price during the war.

BORAX.

This industry is practically controlled by two large companies—the Pacific Coast Borax, and the Sterling Borax Company, the former having deposits in San Bernardino County, while the latter is at Lang, Los Angeles County.

The Sterling Borax Company closed its plant during the latter part of the year but will resume operations shortly, it is reported.

To what extent the discovery of a large deposit of colemanite near Las Vegas, Nevada, will affect these companies is as yet unknown. It is stated, however, that this new deposit may prove to be a strong competitor of the California borax properties.

POTASH.

While potash is found in Inyo, Kern and San Bernardino counties, it is in the latter it has seen its greatest development.

On the shores of Searles Lake millions of dollars have been spent by the American Trona, Boro Solvay, and the West End Chemical companies.

The competition of German potash now is having a most serious effect on these companies, and unless the new tariff gives sufficient protection they are liable to be forced to close down permanently. During the year the American Trona Company suspended operations.

SODA.

This is found in Inyo and San Bernardino counties.

It is at Owens Lake, Inyo County, that the soda industry has been most highly developed.

Natural Soda Products Company. Plant situated on the east shore of Owens Lake, two miles south of Keeler. Has a plant capacity of 24,000 tons dense ash per year, and markets its product on the Pacific Coast and the Orient.

1921 proved to be very prosperous, and the outlook for 1922 is fully as good as this year.

California Alkali Company. Works located on west shore of Owens Lake at Cartago on the Owenyo branch of the Southern Pacific Railroad. Has a capacity of 100 tons dense ash per day, and operated during the year.

COMMON SALT.

There are deposits of common salt in Inyo, Kern, San Bernardino and Riverside counties.

In San Diego County salt is obtained from the Pacific Ocean, near San Diego, by solar evaporation.

There was practically no increase in production over 1920 during the year.

In San Bernardino County the Avawatz Salt and Gypsum Company has 52 claims, approximately 5200 acres, ten miles west of the Tonopah and Tidewater Railroad. While only assessment work is being done at present, the company has prepared complete plans to exploit their deposits not only for salt but also gypsum, celestite and talc which are found on their holdings. It will be necessary for this company to build a 17-mile railroad to a point about 69 miles north of Ludlow to connect with the Tonopah and Tidewater Railroad. The coming year will probably see the begininng of work on the proposed plans of the company.

MISCELLANEOUS ALKALINE SALTS.

The American Magnesium Company has 1440 acres, 20 miles northeast of Searles Lake, containing deposits of magnesium sulphate, aluminum sulphate and sodium sulphate. It proposes the erection of a plant on the Trona Railway which will have a capacity of 15,000 tons of chemical products of which 6000 tons will be potash alum and 9000 tons of magnesium carbonate. It will obtain its potash from the American Trona Company. It proposes to lay a fiber pipe line 28 miles long to carry the brine from the deposit to its plant on the Trona Railway. T. H. Wright, 215 W. 4th street, Los Angeles, is president of the company.

PETROLEUM AND GAS IN CALIFORNIA IN 1921.

By R. E. Collom.

During the year 1921 California has established a new record in the production of petroleum. It is estimated that production for 1921 will be close to 114,000,000 barrels. This production exceeds that of 1920 by over 8,000,000 barrels. It is the greatest quantity of oil yet produced in a single year in California. Records of production and consumption for the year 1920 showed that about 8,000,000 barrels of oil was drawn out of storage. This amount, added to the production of 1920, was necessary to satisfy market requirements, which were close to 114,000,000 barrels. The production of 1921 was about equal to the marketing requirements of 1920 but it is estimated that 13,000,000 barrels of the production of 1921 was not needed to meet the market and therefore run into storage.

In the face of the greatest production in the state's history, the oil business in California has remained fairly steady, although the local overproduction, general industrial depression, and a sympathetic adjustment to the slump in Eastern oil fields, caused two drops in the price of crude, at the well, during the year. However, the oil business in California was not subjected to the violent fluctuations which affected the industry elsewhere in the United States. It is probable that the price of crude oil, at the well, as of December, 1921, will be increased in 1922.

California entered the year 1921 with available stored oil reduced to a minimum and the oil business exerting itself to increase production to a pace in keeping with the indicated demands for 1920. However, there came a curtailment in demands for petroleum, and early in 1921 marketing companies started running part of the crude oil into storage.

For the first eight months of 1921 production averaged 10,100,000 barrels per month. This indicated that the state would produce over 120,000,000 barrels during the year. These figures were not met, however, because of the oil workers' strike in the San Joaquin Valley fields during part of the month of September and all of October, which retarded producing operations to the extent of leaving over 7,000,000 barrels of oil in the ground which, under normal activity, would have been produced and run into storage. The San Joaquin Valley oil fields produced 53 per cent of their normal output during the strike. The Elk Hills oil field, which early in 1921 was producing as much oil as the combined production of the 1900 producing wells of the Coalinga, Belridge and Lost Hills fields, produced almost to full capacity during the strike.

The maximum monthly production for California, in 1921, was reached during May. The production was 10,450,131 barrels. During May, 42 wells in the Elk Hills produced 1,794,156 barrels of oil, that is, less than one-half of one per cent of the oil wells of California produced 17 per cent of its oil.

In Los Angeles and Orange counties the production was considerably increased during the year by the discovery of several new fields and the

unusual development of such fields as Huntington Beach. Shell Company of California contributed the Long Beach oil field by bringing in a well on Signal Hill. Union Oil Company of California greatly extended the productive area at Santa Fe Springs with the "Bell" well in Sec. 31, T. 2 S., R. 11 W., S. B. B. and M. The Chanslor-Canfield Midway Oil Company (Santa Fe Railroad) got some production in its well No. 'Del Amo' 1 at Redondo Beach, which gave promise to the possibilities of another new field. With these new developments in prospect it is probable that the production of Los Angeles and Orange counties will be still further increased in 1922.

The developments at Huntington Beach, especially the phases of speculative activity, drew public attention to the fields of southern California during the year. The unscrupulous promotion of stock selling enterprises, without the necessary acreage or working capital to insure a reasonable return on investments, caused the withdrawal of considerable public support from the normally necessary function of wildcat drilling. Much wildcat drilling was done in Riverside, San Diego, Imperial and other southern counties, but no oil fields were developed outside of Los Angeles and Orange counties.

In Ventura County the production for 1921 was approximately the same as that of 1920. The increased production from new wells was about sufficient to offset the declines in production of oil wells.

In the coastal counties north of Ventura, of which the principal oil producer is Santa Barbara County, there was no appreciable change in oil production. Several unsuccessful ventures in wildcatting were concluded during the year. The most notable of these was the so-called 'Flint' well of Shell Company of California in Sec. 32, T. 24 S., R. 12 E., M. D. B. and M., which was recently abandoned.

In Kern County, which normally produces about 50 per cent of the oil of the state, the Elk Hills oil field was the most important development. The production from this field was undoubtedly the key factor to the relations existing between supply and demand for petroleum during 1921. A number of federal leases were let, under the Land Leasing Act of February, 1920, on government lands in the Elk Hills. In addition, the U. S. Navy Department assigned certain acreage in Naval Petroleum Reserve No. 1 to the Department of the Interior, which department, in turn, leased the land to private concerns for development. Pan American Petroleum Company and W. R. Ramsey, of Oklahoma, were the successful bidders for leases to drill a strip of land along the northern and eastern borders of Sec. 1, T. 31 S., R. 24 E., M. D. B. and M., Naval Petroleum Reserve No. 1.

Aside from Elk Hills the principal interest in wildcat operations in Kern County was centered in the Buttonwillow area. Several concerns drilled deep holes in this area, developing gas under high pressure, which interfered greatly with drilling, but failed to get production of oil, although some showings were reported. This area still requires careful prospecting and testing before its status as a prospective oil field is finally determined.

In Fresno County there was no change of importance in the production of oil. Not considering wildcat activities in counties north of San Francisco, the Tulare Lake region in Kings and Tulare counties seemed to attract most public attention. Several wells drilled near Tulare Lake

have developed gas, but as yet no authentic showings of oil have been reported. The status of Tulare Lake area, as regards petroleum, is still problematical.

Wildcat drilling was quite general throughout the state in 1921. Wells were drilled from Del Norte County in the north to San Diego County in the south. Fresno, Kern, Santa Barbara, Ventura, Los Angeles and Orange counties, however, still continue to be the six principal petroleum producing counties.

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